Municipal and County Engineering

DESIGN, CONSTRUCTION, OPERATION AND MAINTENANCE OF ALL PUBLIC WORKS

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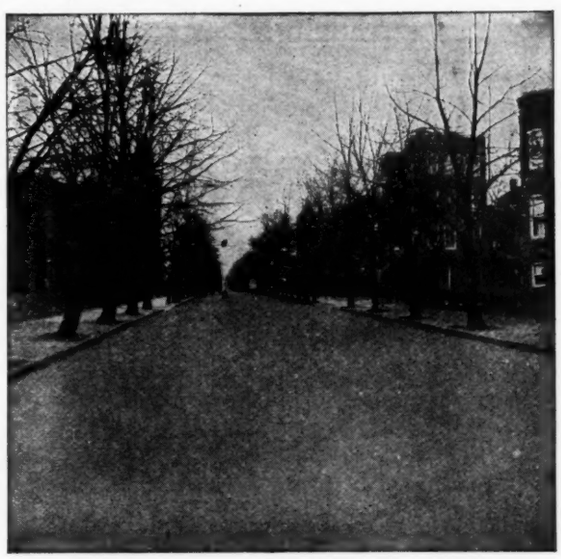
628.05 M92 July-Dec. 1919

Less-than-five-year-old Imitation Asphalt

? Which would you specify ⟷



Twenty-five-year-old Trinidad Sheet Asphalt

Which is the Cheaper?

The worn-out street cost 10 cents per yard less to pave in the first place. Plated ware is always cheaper than "sterling" silver.

But at the end of the fifth year which is the cheaper? The plated ware had to be thrown away, but the "sterling" ware was as good as new.

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"Seasoned for Centuries"

the "sterling" paving material, is still as good as new at the completion of *twenty-five* years of service. If the imitation street was re-paved every fifth year for twenty-five years, it comes near being five times more expensive without figuring the overhead of inconvenience and trouble to those who use the street.

Trinidad bears Nature's stamp of approval.

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"As in other recent years, imports of high-grade **Natural (*Lake*) Asphalt** from Trinidad and Venezuela in 1917 exceeded the combined production of all varieties of Native Bitumen produced in the United States in that year."

U. S. Geological Survey Report October, 1918

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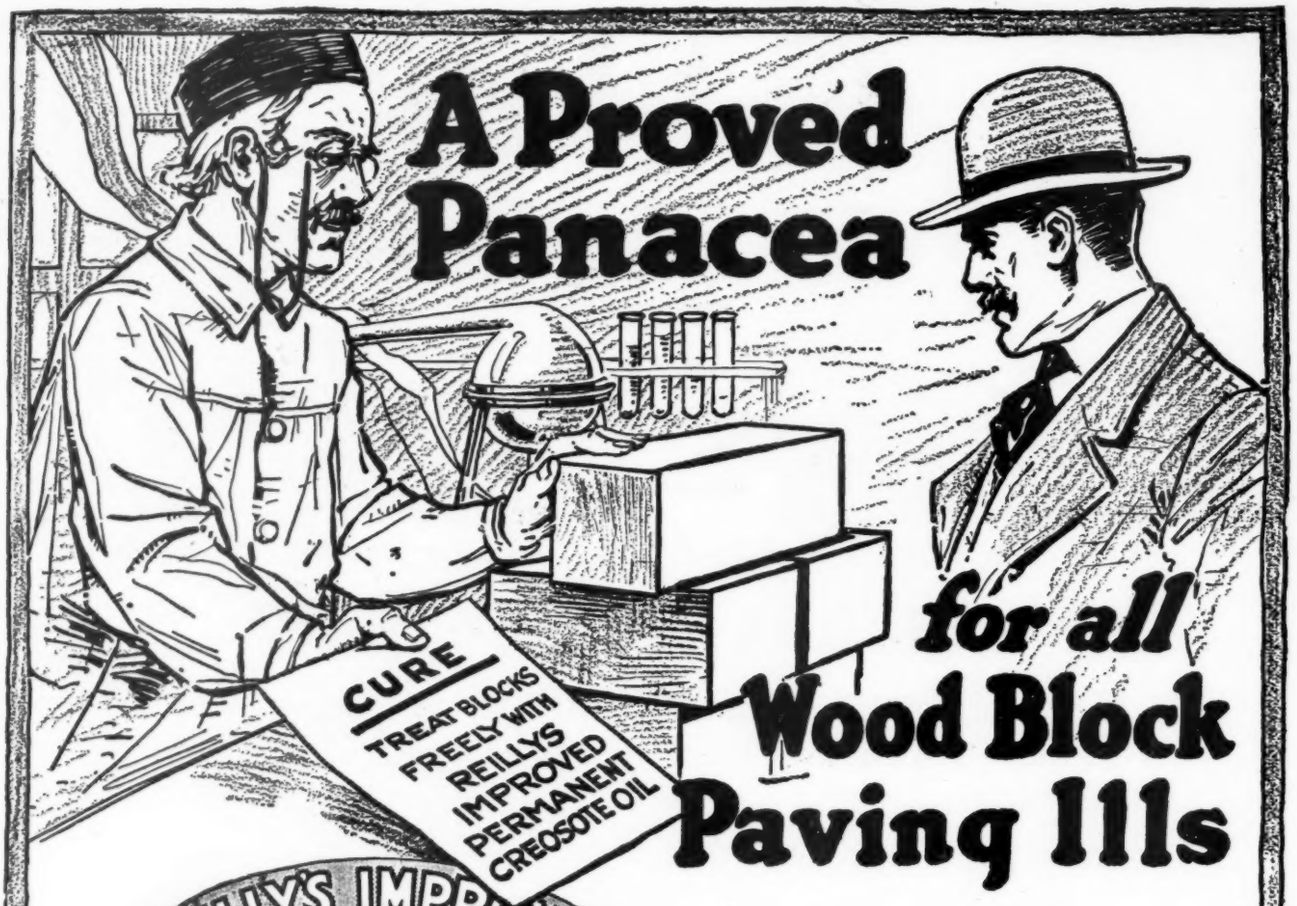

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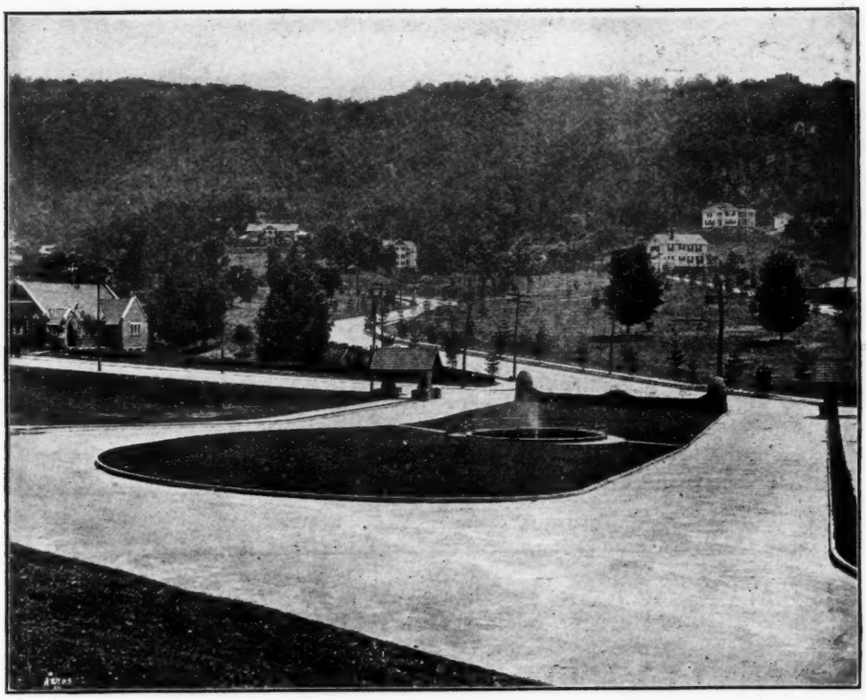

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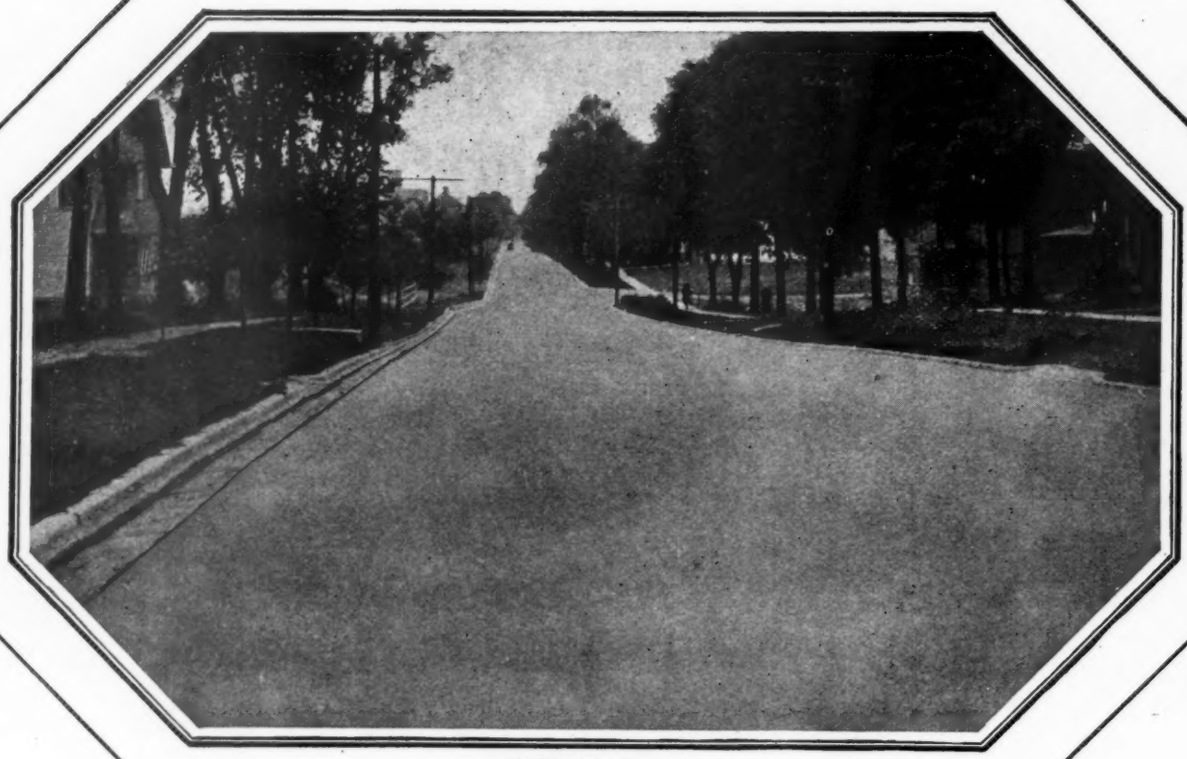

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Bulletin No. 0213 gives further details.
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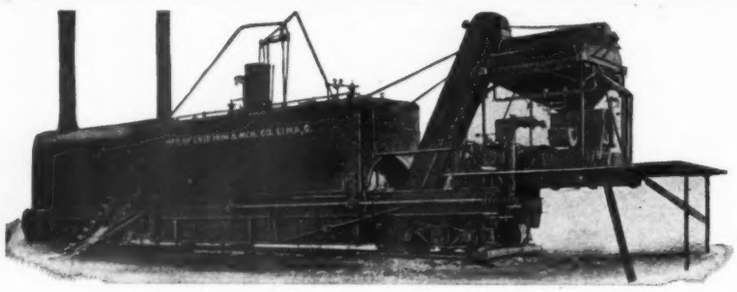

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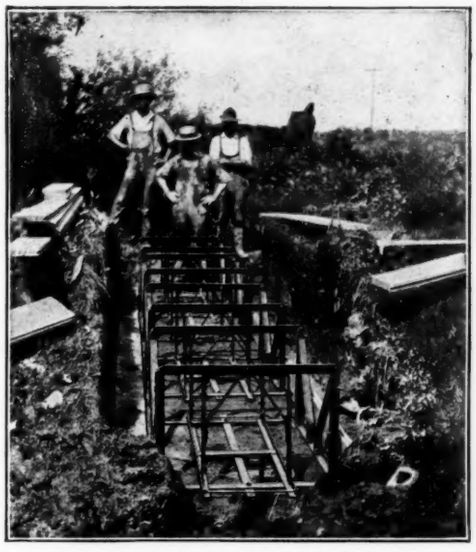

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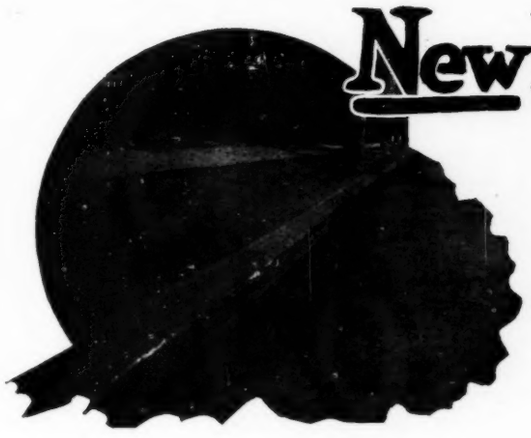

New Pavement Old Curbing

Waterloo Road, Cleveland, had to be repaved in 1916, but the "Buckeye Berea" Curbing, laid with the original pavement thirteen years ago, was as good as when originally set. (Above photo taken August, 1917.)

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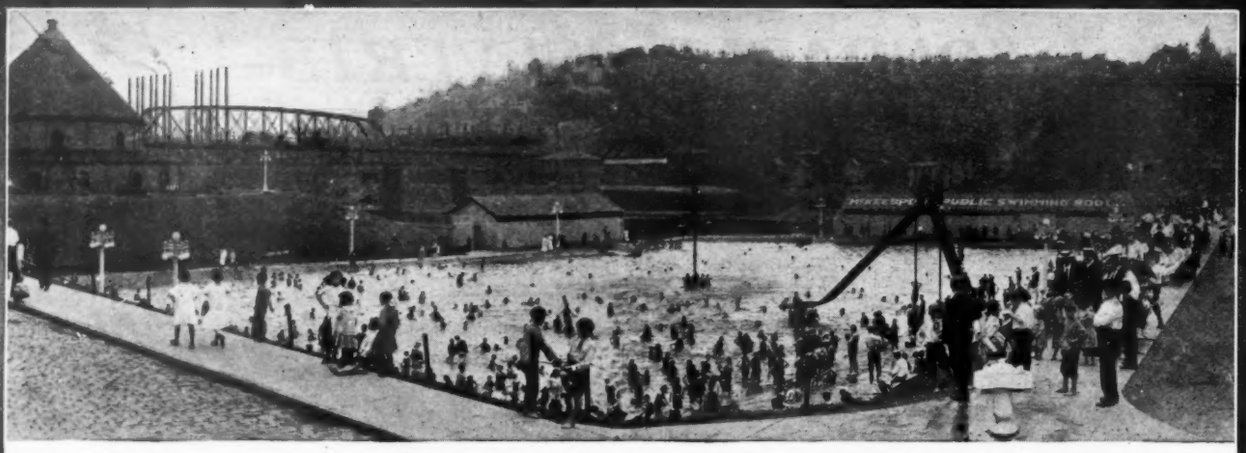

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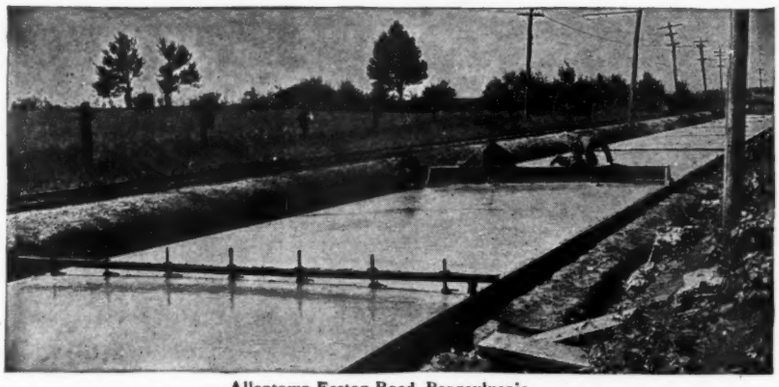

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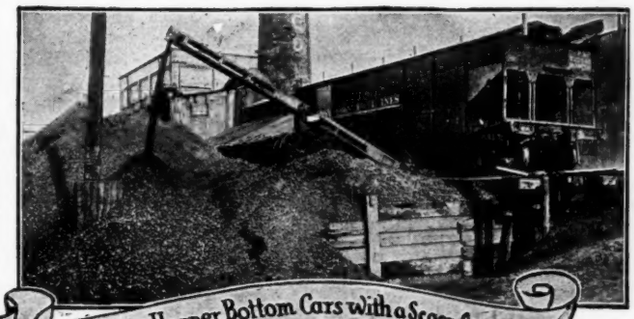

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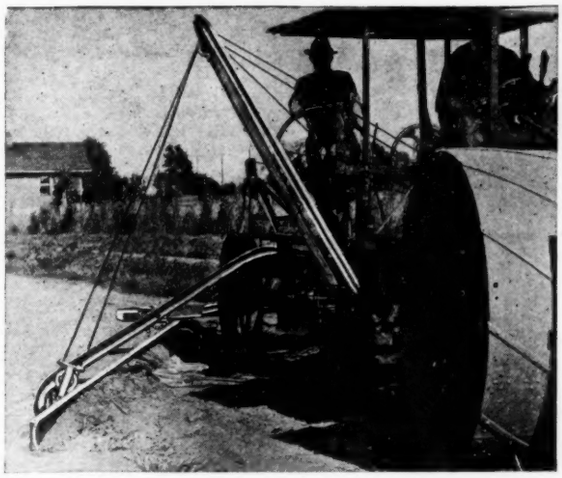

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Edge Protector.
Truscon Steel Co.

Elevating Graders.
Austin-Western Road Machinery Co.

Engines.
Wisconsin Motor Mfg. Co.

Engineering Instruments.
Kolesch & Co.
Lufkin Rule Co., The

Excavating Machinery.
F. C. Austin Co., Inc.
Koehring Machine Co.
Pawling and Harnischfeger.
Sauerman Bros.

Expansion Joint Compound.
The Barrett Co.
H. H. Robertson Co.
Truscon Steel Co.

Explosives.
E. I. DuPont DeNemours & Co.

Fillers (Paving Joint).
The Barrett Co.
H. H. Robertson Co.
The Texas Co.

Fire Brick.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Flue Liners.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.
McNutt, Lewis

Forms, Sidewalks, Curb & Gutter.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Forms, Road.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Forms (Sewers & Conduits).
Heltzel Steel Form & Iron Co.

Forms (Wall Bldg., Construction, Etc.).
Heltzel Steel Form & Iron Co.

Gas Pipe.
American Cast Iron Pipe Co.
Cast Iron Pipe Publicity Bureau

Graders.
Austin-Western Road Machinery Co., The

Graders, Elevating.
Koehring Machine Co.

Graders, Turbine.
Koehring Machine Co.

Gravel Screener and Loader.
The Jordan & Steele Mfg. Co., Inc.

Heaters (Rock and Sand).
Littleford Bros.

Heating Wagons (Oil and Tar).
Littleford Bros.

Hoists (Concrete, Gasoline and Hand).
Pawling and Harnischfeger

Hoists, Electric.
Pawling and Harnischfeger.

Hoists, Steam.
Lewis-Hall Iron Works.

Hot Mixers.
F. C. Austin Co., Inc.
Koehring Machine Co.

Inlets (Sewer).
Dee Co., Wm. E.
Madison Foundry Co.

Insulating Material.
The Barrett Co.
H. H. Robertson Co.

Joint Fillers (Paving).
The Barrett Co.

Kettles (Portable).
Cummer & Son Co., The F. D.

Manhole Covers.
Madison Foundry Co.
Dee Co., Wm. E.

Meter Boxes.
Ford Meter Box Co., The

Concrete Roads must be reinforced

It is demonstrated beyond doubt that to make concrete roads proof against heavy motor traffic, weather and time a fabric of steel must be incorporated in the concrete.

Several great States have so ruled.

American Steel and Wire Company's

Concrete Reinforcement

Fulfills every engineering requirement.

Send for our book on road building

CHICAGO
NEW YORK
CLEVELAND
PITTSBURGH
DENVER

BITOSLAG

Reg. U.S. Pat. Office

AN improved asphaltic concrete pavement composed of finely ground slag and especially prepared asphalt.

Bitoslag has demonstrated in practice that is is designed to meet all the demands of modern traffic.

Write for descriptive matter.

Bitoslag Paving Co.

90 West St., New York, N. Y.

Speed Up Gravel Production

Maximum development of the country's resources of natural road building material is essential to the rapid completion of the vast mileage of good roads for which hundreds of millions of dollars have been appropriated by the government and the various states.

The production of gravel to meet the huge demands of the road builders is, first of all, an excavating problem.

SAUERMAN DRAGLINE CABLEWAY EXCAVATORS

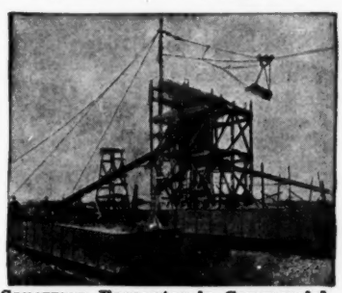
are machines of superior merit for excavating sand and gravel.

No other type of machine possesses the ability to cover an area of 500 ft. radius and dig, convey, elevate and dump material in one continuous operation without help of intermediate machinery.

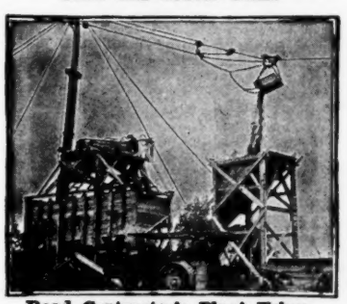
No other type of excavator can excavate gravel from a stream or pool and convey to bins, hopper or cars. Sauerman Dragline Cableway Excavators are as efficient in digging under water as in a dry pit.

Sauerman outfits are economical to operate. One man at the levers of a two-drum hoist controls all the operations of digging, conveying, elevating and dumping. After dumping, the bucket returns to the digging point by gravity.

The experience of our engineers in installing our cableway excavators for hundreds of sand and gravel producers and contractors is at your service if you have a gravel deposit to develop or any similar excavating problem. Write us today.



Sauerman Excavator in Commercial Sand and Gravel Plant



Road Contractor's Plant Using One of Our Machines

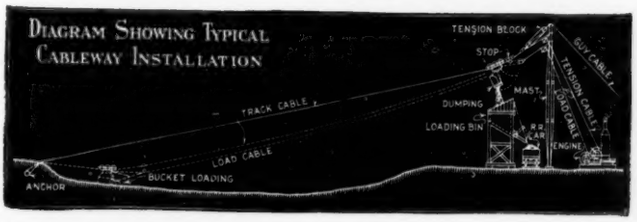
Bucket Can Be Dumped at Any Desired Point on Cableway

Sauerman Bros.

1142 Monadnock Block

Chicago

Mnfrs. of Cableway Excavators Power Scrapers and Cableway Accessories



BUYERS' GUIDE

Mixers, Asphalt.
F. C. Austin Co., Inc.
Cummer & Sons Co., The F. D.
Koehring Machine Co.

Mixers, Concrete.
F. C. Austin Co., Inc.
Koehring Machine Co.

Molds (Pipe & Culvert).
Heltzel Steel Form & Iron Co.

Motor Fire Apparatus.
Acme Motor Truck Co.
Federal Motor Truck Co.
Garford Motor Truck Co.
The Gramm-Bernstein Motor Truck Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Pierce-Arrow Motor Car Co.
Service Motor Truck Co.
J. C. Wilson Co.

Motor Trucks.
Acme Motor Truck Co.
Autocar Co.
Federal Motor Truck Co.
Duplex Truck Co.
The Gramm-Bernstein Motor Truck Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Pierce-Arrow Motor Car Co.
G. A. Schacht Motor Truck Co.
Service Motor Truck Co.
J. C. Wilson Co.

Motor Truck Flushers, Sprinklers and Oilers.
Acme Motor Truck Co.
Autocar Co.
F. C. Austin Co., Inc.
Federal Motor Truck Co.
Garford Motor Truck Co., The
The Gramm-Bernstein Motor Truck Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Pierce-Arrow Motor Car Co.
G. A. Schacht Motor Truck Co.
Service Motor Truck Co.
J. C. Wilson Co.

Municipal Castings.
Dee Co., Wm. E.
Ellwood Foundry
Madison Foundry

Paints (Asphalt).
Barrett Co., The
H. H. Robertson Co.
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Paving Blocks (Creosoted).
The Barrett Co.
Republic Creosoting Co.

Paving Brick.
Medal Paving Brick Co.
Murphysboro Paving Brick Co.
National Paving Brick Mfrs. Assn.
Springfield Paving Brick Co.

Paving Contractors.
Warren Bros. Co.

Paving Joint Compound.
The Barrett Co.
H. H. Robertson Co.
Truscon Steel Co.

Paving Joint Filler.
The Barrett Co.
H. H. Robertson Co.

Paving Machines.
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Koehring Machine Co.
Warren Bros. Co.

Paving Plants (Asphalt).
F. C. Austin Co., Inc.
Cummer & Son Co., The F. D.
East Iron & Machine Co.
Koehring Machine Co.
Warren Bros. Co.

Pipe Dip and Coatings.
The Barrett Co.
Pioneer Asphalt Co.
H. H. Robertson Co.
The Texas Co.

Pipe Manufacturers.
American Cast Iron Pipe Co.

Pitch Filler.
The Barrett Co.
Warren Bros. Co.

Plows (Rooter and Wing).
Austin-Western Road Mach. Co.

Portable Paving Plants.
F. C. Austin Co., Inc.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Koehring Machine Co.
Warren Bros. Co.

Portable Stone Bins.
Austin-Western Road Machinery Co.

Powder.
DuPont, DeNemours & Co., E. I.

Pumps (Contractors).
Holzbog & Bro., Geo. H.

Reinforcing For Pavements.
American Steel and Wire Co.
H. H. Robertson Co.
Truscon Steel Co.

Road Building Material.
Barber Asphalt Paving Co.
H. H. Robertson Co.
The Texas Co.

Road Binder.
The Barrett Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Bros. Co.

Road Forms.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Road Graders.
Austin-Western Road Machinery Co., The
Baker Mfg. Co.

Road Machinery.
F. C. Austin Co., Inc.
Austin-Western Road Machinery Co., The
Baker Mfg. Co.
Beach Mfg. Co.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Koehring Machine Co.
Warren Bros. Co.

Road Planer.
Austin-Western Road Machinery Co.

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The Barrett Co.
DuPont Chemical Co.
Standard Oil Co. (Indiana)
The Texas Co.

Road Rollers.
Austin-Western Road Machinery Co., The
Barber Asphalt Paving Co.

Rock Crushers.
Austin-Western Road Machinery Co., The
Williams Patent Crusher & Pulverizer Co.

Rock and Sand Heaters.
East Iron & Machine Co., The

Roof Coating.
DuPont Chemical Co.

Roofing Material.
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The Barrett Co.
DuPont Chemical Co.
H. H. Robertson Co.
The Texas Co.
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Sand Dryers.
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Sandstone.
Cleveland Stone Co.
Ohio Quarries Co.

Sanitary Carts.
Holzbog & Bro., Geo. H.

Scarifiers.
Austin-Western Road Machinery Co., The

Scrapers, Drag Line.
Pawling and Harnischfeger.
Sauerman Bros.

Scrapers, Graders, Plows, Etc.
Austin-Western Road Machinery Co.

Scrapers, Power.
Sauerman Bros.

Sewage Pumps.
Holzbog & Bro., Geo. H.

Sewage Treatment.
Direct Oxidation Process Corp.
Electrolytic Sanitation Co.
Wallace & Tiernan Co., Inc.

Sewer Braces.
Kalamazoo Fdry. & Mach. Co.

Sewer Castings.
Dee Co., Wm. E.
Madison Foundry Co.

Sewer Cleaning Machinery.
Stewart, W. H.

Sewer Forms.
Heltzel Steel Form & Iron Co.

Sewer Pipe.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.
McNutt, Lewis
Vitrified Pipe Mfrs. Assn.

Sewer Rods.
Stewart, W. H.

Sidewalks (Stone).
Cleveland Stone Co.
Ohio Quarries Co.

Sluice Gates.
Coldwell-Wilcox Co.

Snow Removal Machinery.
Austin Co., Inc., F. C.

Sprinklers.
F. C. Austin Co., Inc.
Austin-Western Road Machinery Co., The

Steel Joists, Studs and Sash.
Truscon Steel Co.

Steel Tapes.
Kolesch & Co.
Lufkin Rule Co., The

Stone Crushers.
Austin-Western Road Machinery Co.
Williams Patent Crusher & Pulverizer Co.

Stone Gurbing.
Cleveland Stone Co.
Ohio Quarries Co.

Stone Elevators.
Austin-Western Road Machinery Co.

Stone Flagging.
Cleveland Stone Co.
Ohio Quarries Co.

Stone Spreaders.
Austin-Western Road Machinery Co.
Burch Plow Works Co.

Stone Screens.
Austin-Western Road Machinery Co.

Street Cleaners' Carts.
Holzbog & Bro., Geo. H.

Street Cleaning Machinery (Horse Drawn).
Austin-Western Road Machinery Co., The

Street Crossings.
Cleveland Stone Co.
Ohio Quarries Co.

Street Flushers (Horse Drawn).
Austin-Western Road Machinery Co.

Street Paving Material.
Barber Asphalt Paving Co.
The Texas Co.

Street Sprinklers (Horse Drawn).
Austin-Western Co., Ltd., The

Structural Steel.
Lewis-Hall Iron Works.

Surveyors' Instruments.
Kolesch & Co.
Lufkin Rule Co., The

Sweepers.
F. C. Austin Co., Inc.
Austin-Western Road Machinery Co., The
Elgin Sales Corp.

Tamping Machines.
Pawling and Harnischfeger.

Tanks, Water Supply.
Mensch, L. J.

Tar and Pitch.
The Barrett Co.
DuPont Chemical Co.

Tar Heaters.
Alger Supply Co.
Littleford Bros.

Tarvia.
The Barrett Co.

Testing Chemists.
Dow & Smith
Howard, J. W.
Kirschbraun, Lester
Van Trump, Isaac.

Traction Engines.
Austin-Western Road Machinery Co., The

Traction Engines (Oil or Kerosene).
Austin-Western Road Mach. Co.

Tractors.
F. C. Austin Co., Inc.

Trailers.
Warner Mfg. Co.

Trench Braces.
Kalamazoo Fdy. & Mach. Co.

Trench Machinery.
F. C. Austin Co., Inc.
Buckeye Traction Ditcher Co.
Holzbog & Bro., Geo. H.
Kalamazoo Fdy. & Machine Co.
Pawling and Harnischfeger

Valves.
Coldwell-Wilcox Co.

Wall Coping.
Cannelton Sewer Pipe Co.

Warrenite.
Warren Bros. Co.

Water Pipe.
American Cast Iron Pipe Co.
Cast Iron Pipe Publicity Bureau

Waterproofing.
Barber Asphalt Paving Co.
Barrett Co., The
H. H. Robertson Co.
The Texas Co.
Truscon Steel Co.

Water Purification.
Direct Oxidation Process Corp.
Electric Ozone Sterilizer Co. of America.
Electrolytic Sanitation Co.
Pennsylvania Salt Mfg. Co.
Wallace & Tiernan Co., Inc.

Water Works Supplies and Equipment.
American Cast Iron Pipe Co.
Alger Supply Co.
Cast Iron Pipe Publicity Bureau
Coldwell-Wilcox Co.
Pennsylvania Salt Mfg. Co.

Wheeled Scrapers.
Austin-Western Road Machinery Co.

Windows (Steel).
Truscon Steel Co.

Wire-Cut Lug Brick.
Medal Paving Brick Co.
Murphysboro Paving Brick Co.
Springfield Paving Brick Co.

Wood Block (Creosoted).
Barrett Co., The
Republic Creosoting Co.

Wood Preservatives.
Barrett Co., The
DuPont Chemical Co.
Republic Creosoting Co.

MOTOR TRUCKS

Motor Trucks as Operated in Municipal and County Service and in Highway Transportation

Short Wheelbase Easy to Operate

THE 97-inch wheelbase Autocar permits a turning radius of 38 feet. A complete circle can be made in the average city street without backing.

Autocar practicability, durability and simplicity of construction combine to create an efficient unit for contractors or municipalities.

Write for catalog which lists more than 700 Autocar users.

CHASSIS (1½ TO 2 TONS)
$2050—97 inch wheelbase
$2150—120 inch wheelbase

THE AUTOCAR COMPANY
Ardmore, Pa. **Established 1897**
Factory branches and dealers in all principal cities

Autocar

Printed as insert to Municipal and County Engineering, Chicago, July, 1919.

MOTOR TRUCK OPERATION AND ACCOUNTING XLVII

Some Costs of Motor Truck Operation

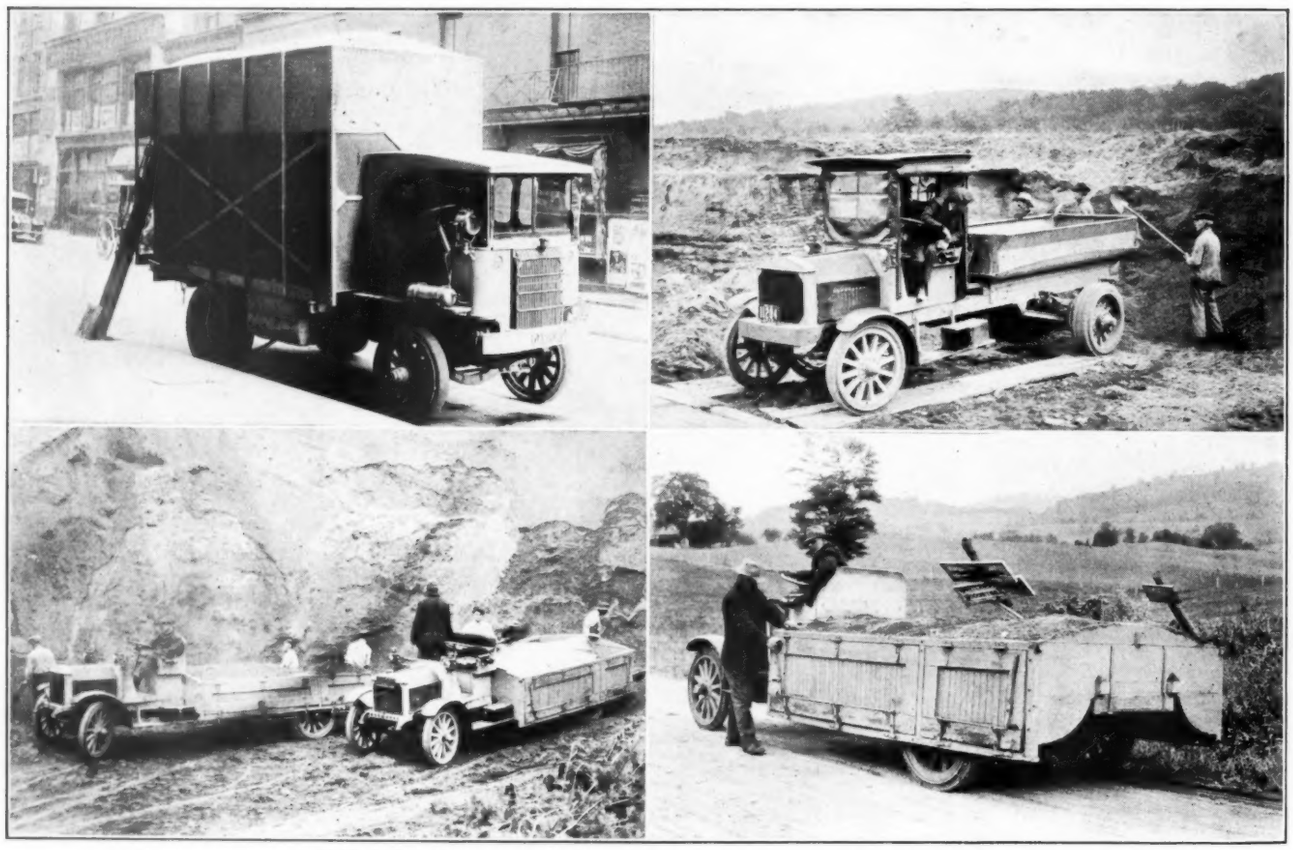
Cost data on motor truck operation in the public works field have been compiled for and published in the recently issued report of the Rochester Bureau of Municipal Research Inc., on the Problem of Refuse Collection in the City of Rochester, N. Y. The data are drawn from various localities and are given herewith:

In 1914 a 5-ton truck equipped with a specially designed 10-yd. collection body was given a trial in house-to-house collection of garbage and ashes on a three mile haul in the Borough of the Bronx, New York City. It was given a further trial in hauling garbage from relay stations in the outlying sections of the Borough. On the three mile haul in making house-to-house collections the truck did not prove as economical as the one-horse carts generally used. But in hauling from relay stations on the longer haul the truck showed a considerable saving over horse-drawn carts. The haul for this work was approximately seven miles. The truck made four round trips for a total of 54.2 miles and hauled 27.6 tons of garbage as against about 1½ trips made in the same length of time by a one-horse cart hauling approximately 1½ tons ($\frac{9}{10}$ tons per load). On the shorter haul the cart made three round trips per day for a total distance of 18 miles including house-to-house collections and hauled 5.4 tons; the truck made five round trips for a total distance of 32.7 miles and hauled 23.85 tons.

The poorer showing of the truck on house-to-house collections was attributed to the time spent in loading. Although four helpers were provided the time so spent represented more than one-half the total time. The time spent in traveling to and from the dump was only one-fifth the total time. On relay work, however, the loading time was only 35 per cent of the total time.

The one-horse cart outfit cost $4.32 per day. The total daily cost of operating the truck was $13.70, distributed as follows:

Item	Total Cost	Per Cent of Total
Gasoline	$2.41	17.6
Oil	.75	5.4
Truck Depreciation (Cost $5,000, life 5 years) . . .	2.78	20.3
Interest on investment at 6%	.83	6.1
Repairs, labor, materials, tires, grease, and miscellaneous	4.07	29.7
Garaging	.30	2.2



VIEWS OF MOTOR TRUCKS IN MUNICIPAL AND COUNTY SERVICE.

Top Row: Motor Driven Power Blower, for Removing Ashes from Cellars, Mounted on Garford Truck as Operated by Ash Removal, Inc., New York City—Federal 3½ Ton Truck as Operated by City of Lebanon, N. H., in Hauling Sand for Public Improvement Work. Bottom Row: Views of Federal 2 Ton Trucks as Operated by J. A. Gould, Windsor, Vt., Equipped with Special Low, Side Dumping Bodies for Hand Loading at Pits.

Reasons Why One Distributor Decided to Sell

Wilson Dependable Motor Trucks

If you are looking for a line of motor trucks that not only sell well but *stay sold* and *repeat*, read the following excerpts from the statement of the Urban Motor Car Co., Pittsburgh Distributors of Wilson Trucks, telling why, after the most thorough analysis of the manufacture and performance of 22 makes of truck they decided to choose the Wilson:

A Proven Truck Backed by an Old Organization.

"Before we decided to enter the motor truck field in Pittsburgh we considered two very important points:

"First, we wanted a truck on which we could stake our money and our reputation; one that had *proven* itself through hard usage over many years' running. We wanted a truck that could be operated economically in all departments—gasoline, oil and upkeep expense. We wanted a truck which, with only the average attention of the ordinary user, would give year-in and year-out service at a reasonable cost. We insisted upon a truck that we could sell to our customers with full assurance that it would meet all of our ideas in regard to performance, service and upkeep cost.

Second, the organization back of this truck must be an old established firm—not a 'mushroom' growth, but an organization with a steady, healthy building-up, that only the *goodness* of the truck could have made possible. It had to be an organization of men who had *studied* and who *understood* transportation requirements. It had to be an organization that would be able to assist us and our customers in deciding upon the right types of equipment for their particular need. It had to be an organization that built right, used only the best methods to perfect its product. *This was a most important point.* In short, we wanted, back of the truck we were to sell, an old reliable firm that had its foundation on a rock bottom of goodness, and built up by the *success of the truck in the hands of actual users.* And after carefully weighing these matters—*after closely looking over 22 makes of trucks* that are today on the market, we arrived at the decision to sell Wilson D pendable Motor Trucks.

Users are Satisfied.

"When we started our investigation we first determined to find out the success of Wilson trucks in the hands of Wilson users. Mere statements would not convince us. We must have actual facts and figures. We demanded proof. For this reason we went direct to Wilson owners.

Single Sales Grow into Fleets.

"Scores of Wilson users spoke highly of Wilson trucks. But what impressed us most, was the fact that everywhere and every place we went Wilson users were *buying additional Wilson trucks.*

"This was the acid test for us. This proved in our minds the goodness of the Wilson product. This convinced us more than any other one thing that Wilson trucks are good trucks, for we knew, of course, that owners would not repeat on Wilson trucks unless the Wilson truck has absolutely proven in every respect that it was a satisfactory, serviceable and economical product.

The Big Factory Back of the Wilson Truck.

"But even when we found the universal satisfaction that Wilson owners were receiving from Wilson trucks, in all parts of the country, we didn't jump at conclusions.

"*We wanted to know what was back of Wilson trucks.*. So we made a trip to the factory in Detroit and met the Wilson organization.

"The J. C. Wilson Company has been engaged *continuously* in the manufacture of heavy commercial vehicles in Detroit for the past *36 years.* This organization *understands* transportation methods—it has studied them since the inception of its business. It was always in the *front rank* of manufacturers who were devising *improvements* in hauling, even in the days of horse-drawn vehicles.

"And now for nearly seven years Wilson trucks have been built, sold and operated by this same J. C. Wilson Company.

"*And here is the big point—every Wilson truck ever built is still in successful operation.*

"Think of that—trucks in operation for seven years and still going strong!

"This was the clincher. This told us more than anything else. And this resulted in our decision to handle Wilson trucks in Pittsburgh territory.

"We believe that the Wilson truck gives more dollar-for-dollar value than any other truck on the market.

In Conclusion.

"We believe that the Wilson truck can be operated for a lesser expense over a greater period of years than any other truck ever built.

"We believe that the Wilson truck is a better truck for Pittsburgh users because of its great pulling power and its ability to negotiate Pittsburgh hills. Scores of Wilson users in Pittsburgh territory will back up this statement.

"In short, we believe that the Wilson truck is the best truck for year-in and year-out service, low operating costs, fewer repairs, and the ability to carry the load of any truck ever before sold in Pittsburgh.

"There you have our reasons for selling Wilson trucks—reasons we considered and weighed very heavily before we made the final decision."

Take advantage of this analysis and write today for full particulars relative to some very desirable territory still open.

Remember that the rugged construction of Wilson Dependable Motor Trucks assures their success in the construction field.

J. C. WILSON COMPANY—36th Year

Export Office, 100 Broad St., New York. **DETROIT, U. S. A.**

LONDON – PARIS

1, 2, 3½ and 5 ton—All Worm Drive. ***A Model for Every Municipal and County need.***

SERVICE HEAVY DUTY MOTOR TRUCK AS OPERATED BY CONTRACTOR W. J. NEWMAN ON THE NEW UNION STATION JOB IN CHICAGO.

Driver's pay	2.56	18.7
Total	$13.70	100.0

The New York Department of Street Cleaning has used large tractor-trailer motor propelled collection units to some extent. These are giant outfits hauling 25 cu. yds. of refuse per load. Collections of ashes, rubbish and garbage are made simultaneously, but in separate compartments. The average haul is about 1½ miles. Special equipment is provided for unloading the refuse onto scows. The principal factor tending to produce economy from the collection standpoint is the fact that all refuse is dumped at a common point of disposal. For this reason all refuse may be collected at one time by providing separate refuse compartments on the various vehicles.

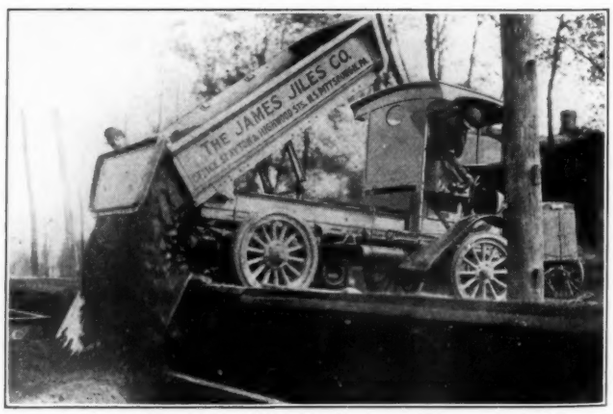
In Philadelphia a part of the collection equipment has been motorized. Five-ton trucks equipped with 12-yd. bodies have proven economical in the collection of ashes and rubbish from sections where the haul to the dump averages 6 miles.

In a report by the Efficiency Division of the Chicago Civil Service Commission made public in July, 1915, it is stated that after a thorough study of the question of motorizing Chicago's collection equipment the continued use of horses in garbage collection was found to be justified. The report states that the data assembled for gas and electric trucks warrant their adoption only for hauling after horse-drawn carts have made the house-to-house collection. These figures are based on a $5.50 daily wage per team. If the cost of teaming were increased to $6 per day, it is stated that there would be a slight saving by using motor equipment, but this would not be sufficient to warrant the change at least for some time to come. The report states that the haul in Chicago varies from 1½ to 5 miles. As between the gasoline and electric trucks, the latter were found to be more economical. The haul below which a 3-ton electric truck would not be economical when measured against a $5.50 team was found to be 1.8 miles. Against a $6 team it was 0.8 mile. Three-ton gasoline trucks were found to be not as economical as either a $5.50 or $6 team.

The fixed and mileage charges for gasoline and electric trucks were as follows.

Item	Total Cost Gasoline	Electric
First cost of 3-ton truck or tractor.....	$4,000.00	$4,000.00
Fixed Charges:		
Fixed charges on investment per year at 4%	160.00	160.00
Garage	300.00	300.00
Insurance (fire and liability)	190.00	183.00
State license	4.00	4.00
Driver	960.00	960.00
Obsolescence, 5%	200.00	200.00
Contingencies (interest on operating stores, general superintendence, etc.), 2%	80.00	80.00
Total fixed charges per year.....	$1,894.00	$1,887.00
Total fixed charges per day (1/300 yr.)	6.31	6.29
Variable Expenses per Mile:		
Depreciation	$0.0473	$0.0340
Tires	.0600	.0600
Maintenance and repairs	.0300	.0300
Lubrication (oil and grease).....	.0050	.0050
Eenergy (gasoline 13½ cents per gallon, electricity ½ cents per kw. hr.)	.0344	.0050
Total variable expense per mile.....	$0.1767	$0.1340

DUPLEX TRUCK AS OPERATED BY FRANKLIN COUNTY, MISSOURI, IN SCARIFYING AND GRADING AN OLD ROAD BED.



VIEW OF AN AUTOCAR DUMPING SAND.

The Short Wheelbase of this Autocar will Permit of its Operation Even in Places Where Horses Could Not Be Used. Operating from the Seat, It Takes About 30 Seconds to Dump Each Load.

Service MOTOR TRUCKS

Are Rapidly Winning Favor in Municipal and County Work

Buyers who investigate thoroly and choose carefully—who take pride in having 100 per cent efficient equipment—find SERVICE the best trucks for municipal work because SERVICE cost sheets need no apology or explanation.

Chicago, Indianapolis, Columbus, Atlanta, Kansas City and many other cities and a large number of counties are using SERVICE Motor Trucks equipped with Dump Bodies, Flushers, Sprinklers, Fire Fighting Apparatus, and Road Grading and Surfacing Equipment.

Here is a Partial List of Users

You are invited to get in touch with the officials of any of the following cities and counties and get first-hand evidence of SERVICE efficiency, dependability, economy, value.

CITIES		COUNTIES	
Chicago, Ill.	Wabash, Ind.	Owen County, Ind.	Boone County, Ind.
Atlanta, Ga.	Lorain, Ohio.	Gibson County, Ind.	Porter County, Ind.
Los Angeles, Calif.	Lodi, N. Y.	Decatur County, Ind.	Mason County, Ky.
Indianapolis, Ind.	Bergerfield, N. J.	Callaway Co., Mo.	Robertson Co., Ky
Niagara Falls, N. Y.	Berne, Ind.	Bath County, Ky.	Pulaski County, Ark.
Kansas City, Mo.	Eau Claire, Wis.	Henry County, Ky.	Jefferson County, Ark.
Columbus, Ohio.	N. Manchester, Ind.	Campbell Co., Ga.	Howard County, Md.
Monticello, Ind.	Salt Lake City, Utah.	Pulaski County, Ind.	Baltimore Co., Md.
		Monroe County, Ind.	

Built *for* service—Backed *by* service

Before you decide the motor truck question, get all the facts about SERVICE. Ask your local distributor or write for full information.

SERVICE MOTOR TRUCK CO., Wabash, Ind., U. S. A.

Distributors in All Principal Cities

NEW YORK—87-89 West End Avenue CHICAGO—2617-25 So. Wabash Avenue

CONSULTING ENGINEER

offers his services for the selection of special motor truck equipment for municipal and engineering uses. For appointment write Captain Whittemore, 219 W. 81st Street, New York, N. Y.

The cost for hauling with horses was given as follows:

Item	Teams Costing $5.50 per Day	Teams Costing $6.00 per Day
Fixed charges for equipment..	$0.021	$0.021
Horses and driver	5.500	6.000
Wagon depreciation, life 22,000 miles	0.084	0.084
Maintenance and repairs at 5%	0.021	0.021
Total daily expense	$5.626	$6.126

In Los Angeles motor trucks are used in the collection of all non-combustible refuse. Two 2½-ton trucks are used to haul garbage from the outlying districts where the haul averages eight miles or more. One driver and two helpers compose the crew and two loads are collected daily. For the remainder of the city on the shorter hauls teams are still used. The cost of garbage collection with motor trucks on the long hauls is given as $2.76 per ton. On the shorter hauls the cost is $2 per ton using teams.

A certain firm in Rochester employing both horses and motor trucks in lumber and building material deliveries states that the economical low limit of haul for motor trucks is found to be 2¼ miles.

The average cost of truck operation by this firm for the last three years has been $11.20 to $12.30 per day. (This includes the cost of two 3-ton and two 2-ton trucks.) Items included are fuel, lubricants, tires, repairs, license fee, liability insurance, garaging, drivers' wages and depreciation. Drivers were paid $17 to $19 per week. Twenty per cent was allowed for depreciation.

Mr. C. V. Montgomery who has charge of a large fleet of motor trucks on paving work in Philadelphia, in a statement places the cost of operating a 5-ton truck 50 miles per day at $17.91. Fixed charges amount to $5.39 per day or 30 per cent of the total. This cost evidently applies to 1916 conditions. The distribution is as follows:

Fixed Charges	Per Day	Per Cent of Total Cost per Day
Depreciation* ($4,100 first cost—$400 scrap value 1,200 days).....	$0.46	2.6
Insurance (liability, fire, collision)	.58	3.2
License fee	.10	.6
Truck foreman (supervising 3 trks.)	1.25	7.0
Driver	3.00	16.7
Total fixed charges	$5.39	30.1

Variable Charges	Per Mile	Per Day at 50-Truck-Miles	Per Cent of Total Cost per Day
Depreciation* ($4,100 cost — $400 scrap value/15,000 mi.) .	$0.0629	$3.14	17.6
Gasoline at 25 cents (3 mi. per gal.)...	.0833	4.17	23.3
Lubricating oil (64 mi. per gal.)	.0055	.27	1.5
Tires	.0386	1.94	10.8
Repairs	.0600	3.00	16.7
Total variable charges	$0.2503	$12.52	69.9
Fixed charges (at 50 mi. per day)	.1078	5.39	....
Total cost per mile ..	$0.3581	.....	....
Total cost per day	.....	$17.91	100.0

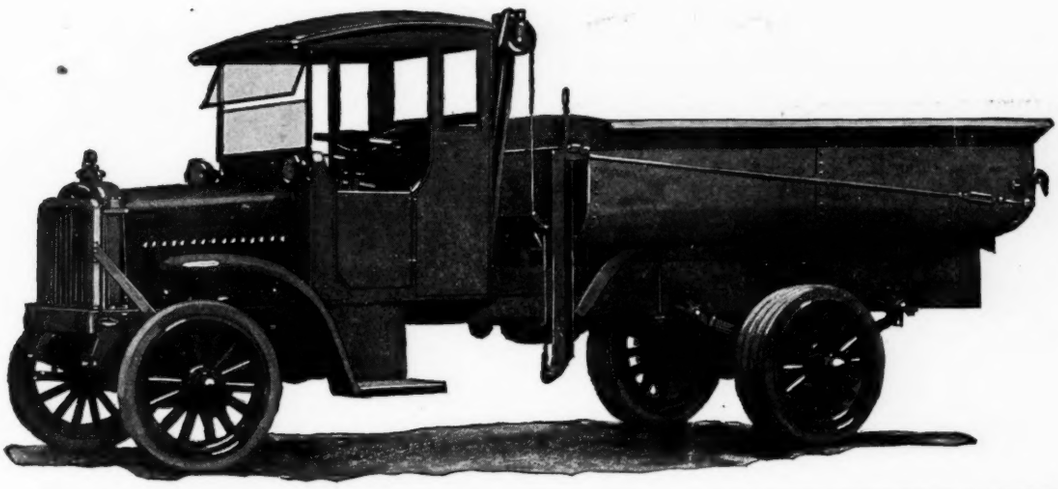
*About 15% of first cost depreciates with passage of time while about 85% is proportional directly to mileage run.

The cost of operating a 5-ton truck used in the delivery of sand and gravel on the Pacific coast during a five-months period in 1917 was approximately $13.40 per day. This includes all charges. Capacity loads were hauled an average distance of 6.1 miles over roads of various kinds, equally divided between gravel and dirt, with many hills, some of them steep. The average distance traveled daily was about 60 miles. The costs were distributed as follows:

DUPLEX FOUR-WHEEL DRIVE TRUCK AS OWNED AND OPERATED BY GENESEE COUNTY, MICH. THIS IS ONE IN OVER FIFTY DUPLEX TRUCKS USED ON ROAD WORK IN MICHIGAN.

Item	Total Cost	Per Cent of Total
Fuel	$303.25	18.1
Oil and Grease	69.79	4.2
Tires	154.93	9.3
Repairs and parts	21.06	1.3
Wages	508.75	30.4

PIERCE-ARROW 5-TON, 14-FT. TRUCK EQUIPPED WITH A 1,200-GAL SPRINKLER TANK, AUXILIARY MOTOR AND SPRINKLER HEADS. THE OUTFIT IS ALSO EQUIPPED WITH A GRADER HITCH, AS SHOWN IN THE INSERTED OVAL, FOR USE ON SPECIAL WORK. THESE GRADER HITCHES BRING THE DRAWBAR PULL CLOSE TO THE GROUND AND ARE USEFUL IN ROAD IMPROVEMENT WORK.



GRAMM PIONEER BERNSTEIN

A Truck Transmission Which Simply Defies Trouble

If there were no other reason for preferring Gramm-Bernstein trucks, B. A. Gramm's transmission alone would be reason enough.

Think of the expensive things which *can*, and *do* happen every day, to truck transmissions. Then note that *not one* of them can happen to ours.

Business men and truck owners blame transmission troubles for fully 60 per cent of usual truck layups.

Eighteen years of truck experience have shown us how to cure the one great and expensive transmission fault.

The Gramm-Bernstein transmission has been so designed that the gears are always in mesh.

They are never shifted—hence they cannot possibly be clashed or ground or chipped.

Speed changes are made by means of patented dog clutches—strong and tough and sturdy. These clutches enable easy shifting at any time and into any speed, going *fast* or *slow*, *up* or *down hill*.

This is especially valuable in hilly and mountainous sections. The driver can throw off his spark and use engine compression for braking purposes—thus saving much wear and expense on brakes.

The gears are mounted on extra large bearings. *They revolve on a heavy six-spline shaft.* They simply cannot get out of alignment.

So the Gramm-Bernstein transmission is driver-proof. It is protected absolutely—by its design, its construction, and its inter-locking speed shift, which prevents getting into two sets of gears at the same time.

It is proof also against every other common trouble. *In its entire assembly, for example, there is not a single pin, stud, set-screw, bolt or key which by any chance could work loose and fall out* with resulting serious damage to the entire gear set.

Replacements from every cause—carefully recorded over a 15-month period, in 1917-8, and covering all our trucks in use—averaged the negligible cost of 40 cents per truck.

So we say this transmission alone is reason enough for preferring Gramm-Bernstein trucks.

It is basic superiority. It goes to the very root of truck value and truck service. It is one of the factors contributing to the continuous hauling and the consequent economy which distinguish Gramm-Bernstein records.

Its tremendous advantages are exclusive to the worm-drive Gramm-Bernstein Pioneer line.

It is noteworthy that Mr. Gramm pioneered the truck industry 18 years ago, that Gramm-Bernstein eight years ago departed radically from then accepted transmission practice, and that this company now registers another departure by offering trucks completely equipped.

Gramm-Bernstein worm-drive trucks are made in 2, 2½, 3½ and 5-ton capacities—sold with complete equipment, at a flat price. Ready for the body—not an extra to buy.

The two-ton chassis, equipped, at $2700, is under the average of prices asked by 61 manufacturers for two-ton chassis without equipment.

Gramm-Bernstein Radiator showing radiator shutter open, radiator guard, pig-tail towing hooks and motometer.

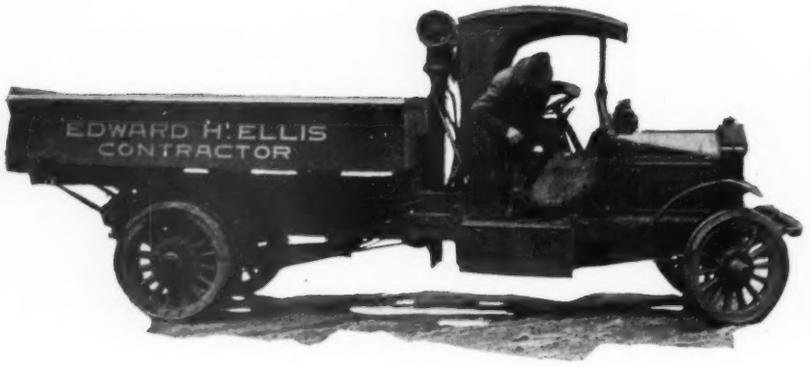
All Gramm-Bernstein transmissions are provided with a pad for attaching Gramm's basic patent power take-off.

Dealers and truck owners should assure themselves that any trucks purchased with power take-off do not infringe B. A. Gramm's Basic Patent No. 1194994.

The Gramm-Bernstein Motor Truck Company, Lima, Ohio, U. S. A.

Pioneers since 1901—Builders of the First Liberty (U. S. A.) Truck

GRAMM PIONEER BERNSTEIN



PIERCE-ARROW 5-TON TRUCK AS OPERATED AT THE HOG ISLAND SHIPYARD BY EDWARD H. ELLIS, OF PHILADELPHIA. OPERATED 24 HOURS A DAY, 7 DAYS A WEEK FOR SIX WEEKS.

Interest at 8%	218.78	13.1
Depreciation at 20%	394.66	23.6
Total	$1671.22	100.0

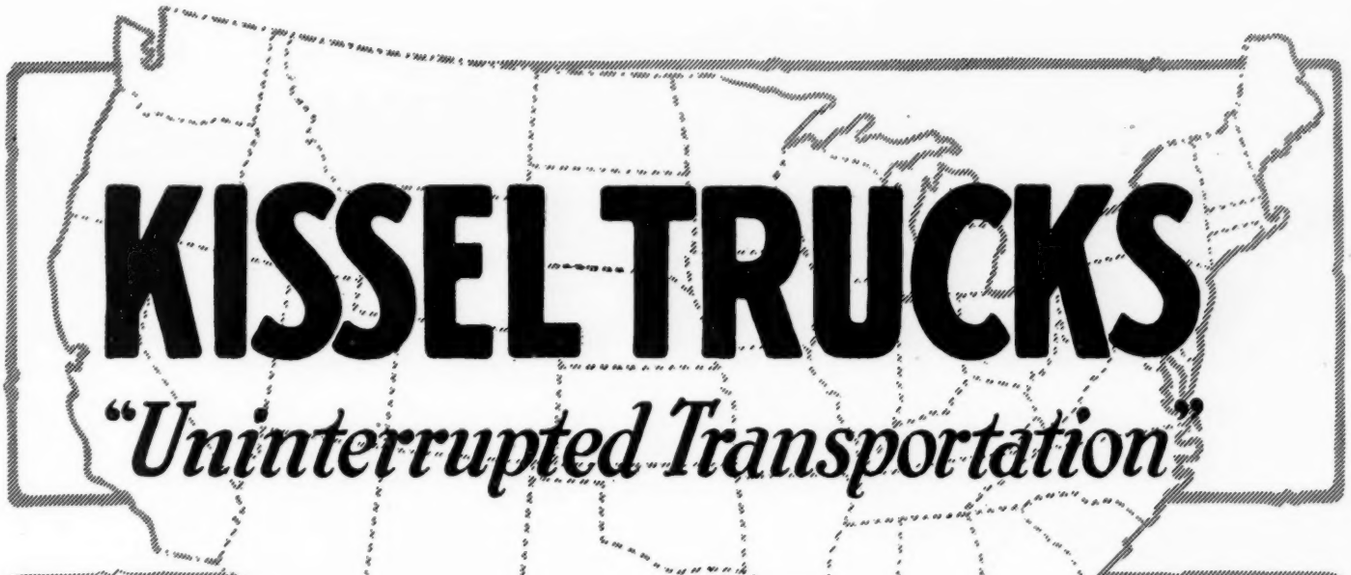
The cost of hauling paving materials in Detroit with a 5-ton truck during 1917 was $14.85 per day, including all costs. The truck hauled an aggregate of 35 tons in seven trips, the average haul being 4½ miles.

The cost of operating a 3½ ton truck under average service conditions on the roads of South California over a considerable period of time was found to be $9 per day. This includes all cost of upkeep, supplies, depreciation, wages of drivers, etc. The first cost of the truck was placed at $3,500 and its life at ten years, assuming that the truck traveled 25 miles per day. Gasoline was purchased at 16 cts. per gal. and the driver's salary was $960 per year. Roads were good and operating conditions generally very favorable. Itemized costs (for the estimated life of ten years) follow:

Item	Total Cost	Cost per day	Per Cent of Total
Insurance	$1,350	$0.45	5.0
License and taxes	380	.13	1.4
Interest at 6%	2,100	.70	7.8
Depreciation	3,500	1.17	12.9
Administration	415	.14	1.5
Storage	960	.32	3.5
Gasoline at 16 cts. per gal.	2,400	.80	8.9
Oil, grease, waste	750	.25	2.8
Tires (less first cost)	2,345	.78	8.7
Driver's Salary	9,600	3.20	35.5
Maintenance	3,250	1.08	12.0
Total for life of truck .	$27,050	$9.02	100.0

The first cost of a truck with a collection body would be somewhat higher than is here given. As a matter of fact, the City of Rochester awarded a contract to the Selden Motor Vehicle Company in December, 1917, for two 3½ ton trucks each equipped with a special 6-yd. collection body at $5,031.35 each. Other costs also have increased proportionately since the above estimate was made. It is believed, however, that a competent driver could be employed at less than $960. It should be possible to employ a truck driver at $900 annually if he were given permanent employment. Also interest rates on the investment should not amount to more than 5 per cent. The life of a truck used in house-to-house collection work would probably not be as long as in other work, due to frequent starting, stopping and generally hard usage. A life of five years with a daily average mileage of 25 miles would seem to be a fair estimate for the useful service derived from the truck. At the end of that time the estimated scrap value would be $500. With these data the following estimate

ACME TRUCK, EQUIPPED WITH DUMP BODY AND HYDRAULIC HOIST, AS OPERATED BY E. J. BAILEY, BROCKTON, N. Y., IN HAULING ROAD-MAKING MATERIAL.



KISSEL TRUCKS

"Uninterrupted Transportation"

Solving the Nations Readjustment Problems

THERE is no question as to the productive ability of America—that has been proven.

The real problem that confronts the American business man is to keep up an endless flow of supplies, materials, goods, etc., to port of shipment.

In other words, there must not be the slightest uncertainty of delivery on schedule time, of necessary living supplies and necessities which not only Europe is looking to us to provide, but on which our Nation's commercial and social life depends.

No truck purchaser can afford to purchase motor trucks backed up by doubtful manufacturing facilities. He cannot afford to trust his transportation problems to trucks that have not demonstrated their mechanical superiority. It is plain, good business judgment to place your choice of trucks in trucks that—value for value—quality for quality—measure second to none; trucks that are backed up by intensive as well as extensive manufacturing and service facilities—trucks that are the result of studying the peculiarities that characterize the delivery and hauling problems of your own business.

The Kissel Truck owners of today made their final choice because investigations proved that they were built on correct mechanical principles, insuring satisfactory and continuous service and performance.

Take the nationally known corporations and industries that employ fleets of Kissel Trucks. Their purchasing experts made no half-hearted investigations; they knew that the rise or fall of their business institutions depended on the successful solution of their transportation problems. Consequently their investigations were sweeping in every detail—they were investigations that only transportation experts know how to make.

Their experience had taught them that a truck in order to endure and survive the grill of exceptional demands and conditions must be built unusually strong. They found that this was the dominating thought in every step of Kissel truck construction, from the selection of material, the testing of the steel and other components, the liberal dimensions and highest grade construction of the frame, axles, springs, brakes, etc.—up to the famous Kissel-built power-plant specially designed for motor truck requirements.

And when it came to a final checking up, the result which caused their decision was that a Kissel Truck chassis was a scientific achievement, strongly built and perfectly balanced.

The unusual transportation demands now being made on every manufacturer and industry, necessitates every truck purchaser taking the chance out of truck buying—the uncertainty out of truck performance—the risk out of truck investing. The great importance of your transportation equipment keeping pace with your production facilities is too vital to trust to any truck but the one that fits your problems.

Kissel long ago found that no two transportation problems are alike. Each requires individual study, intelligent analysis. Your nearest Kissel dealer is prepared to show you how the perfection to which Kissel Trucks have been brought is your protection—protection in your investment—in your haulage delivery and shipping department—in your present and future volume of business.

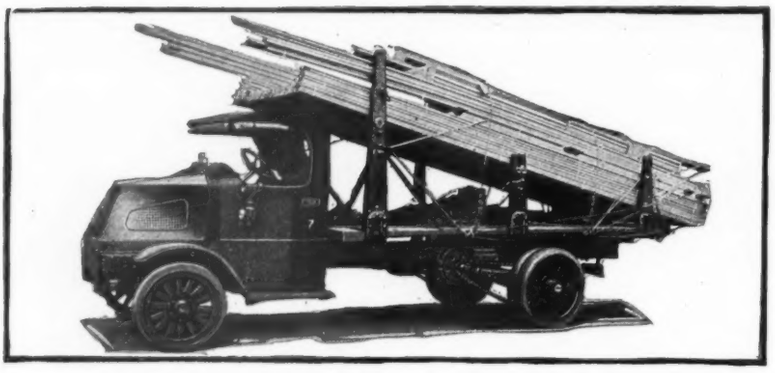
Every Kissel Truck represents eleven years of truck experience and experiments—investigations and tests—with never a failure—and the first Kissel Truck still in active service.

This calls for a truck with unlimited hill-climbing power, speed ability on good roads, wear-durability on bad roads, emergency capacity, rapidity of loading and unloading, ease of operating and driving in traffic zones at low upkeep. These truck requisites that are built into Kissel Trucks are absolutely necessary to solve the unusual readjustment transportation problems which every manufacturer and industry has been called upon to face.

Purchase motor trucks as you purchase any other part of your equipment. You will find it's a good business practice from every standpoint.

Kissel Truck dealers are in every principal city. Literature on request.

Kissel Motor Car Co.
Hartford, Wis., U.S.A.



MACK 5½-TON TRUCK HAULING LUMBER IN 25-FT. LENGTHS FOR A. T. STEARNS CO., NEPONSET, MASS.

is made of the daily cost of operating a truck in ash collection:

Estmated Daily Cost of Operation of a 3½ Ton Motor Truck in Refuse Collection

Fixed Charges:	Total Daily Cost	Per Cent of Total
Depreciation: First cost, $5,031.35, life 5 years, scrap value $500	$0.45	3.5
Insurance (liability $120, fire $45 per yr)	.55	4.3
Storage	.30	2.4
Driver ($900 per year)	3.00	23.6
Interest (5% annually)	.84	6.6
Overhead supervision (same organization as for city stables)	.40	3.2
Total fixed charges	$5,54	43.6

Variable Charges:	Per Mile	Per Day at 25 Miles	Per Cent of Total
Depreciation: First cost $5,-031.35, life 5 years, scrap Value $500	$0.1027	$2,57	20.2
Gasoline at 22 cents/gallon (3 mi. per gallon)	.0733	1.83	14.4
Lubricants (oil, grease, waste)	.0100	.25	2.0
Tires	.0500	1.25	9.9
Repairs and sundries	.0500	1.25	9.9
Total variable charges	$0.2860	$7.15	56.4
Total fixed charges at 25 mi. per day	.2216	5.54	43.6
Total daily cost of operation	$0.5076	$12.69	100.0

It is assumed that a certain amount of depreciation is due directly to the passage of time. In the estimate, therefore, 15 per cent of the total depreciation is included as a fixed charge and distributed over 1500 days, the estimated useful life of the truck. The remaining 85 per cent depreciation is assumed as being directly proportional to the mileage run. Operated 25 miles per day with a life of 1500 days' service, the total distance that the truck would travel would be 37,500 miles. The estimated depreciation for the life of the truck on this basis is 23.7 per cent of the total daily cost of operation. This is rather a big allowance for depreciation, but when the nature of the work is considered it is not too high in comparison to depreciation of trucks used in straight commercial hauling work. A truck used in house-to-house collection work must be started and stopped many times in the course of each loading. The motor must be kept in constant motion because each stop is of short duration. On account of the many starts and stops also the truck must of necessity cover a considerable distance each day at a speed much slower than its economical speed of operation. Combined with all of these factors the truck must be operated continuously in the presence of grit and cinders from ashes and dust from street dirt. For these reasons not only is depreciation sure to be high, but the unit cost of fuel, lubrication, tires and repairs is also bound to be more than similar costs under normal commercial operating conditions.

Performance of a Duplex Truck for Polk County, Oregon

The following extracts are from a letter written in February of this year by Judge E. O. Kirkpatrick of Polk County, Oregon, with reference to the service rendered the county by its Duplex truck:

"The county purchased a Duplex truck last spring and has not been out one cent for repairs other than replacing tires. We first hitched her onto an 8-ft. grader and did more work in one day and better work than could be done with eight horses in three days. We then hitched her to a standard size Russel Scarifier and she walked right off with her in eight inches of hard macadam. The fact is, she can pull an 8-ft. grader or a scarifier in two.

"After we got out road beds in shape we then put her to hauling gravel along with two other trucks, all three loaded with 3 yds. of river gravel. These trucks made as high as 80 miles per day by working long hours.

MACK FLUSHER AND SPRINKLER AS OPERATED BY THE STREET DEPARTMENT OF THE CITY OF ASTORIA, OREGON.

"In conclusion let me say that this Duplex has run 7,000 miles and never for one minute been out of commission except for the usual cleaning and good care. Polk County will purchase another Duplex this coming spring."

The Adrian Community Market

"Such a plan has been worked out with great success at Adrian, Michigan. Here, the Adrian Chamber of Commerce has organized the 'Community market' with a manager in charge. All produce, from popcorn to pigs, is purchased and the farmer receives a price slightly lower than the Detroit market price. The difference is made up from the actual cost of maintaining the market and not from a profit standpoint."

"Hides, skins, tallow, and cordwood are taken as well as cream, eggs, poultry, dressed meats, potatoes and all sorts of produce and apples. The potatoes are graded and No. 2's and 3's take as well as No. 1's. The eggs are candled, poultry graded for heavy and light weight, and all cream is tested. Thus the farmer gets his just due and is encouraged to bring in better products.

"The Adrian Community Market was organized in February, 1918, and began business in April of that year. It has just closed its first year with a record of over $1,000,000 worth of business transacted.

"The value of such a plan is easily seen," says Mr. Pulcher, "and the good other community markets, as efficiently organized, can do to reduce the cost of living to the cities, can also be readily estimated. The motor truck is doing its share to cut the marketing costs and is adding a great deal to the success of the market."

Highway Transport Engineering

By Arthur H. Blanchard, Consulting Highway Engineer, Broadway and 117th Street, New York City

The United States is entering upon a period of phenomenal expansion of highway improvement and motor transport. This country has witnessed a rapid growth in the utilization of the motor vehicle as indicated by the registration of 125,000 motor vehicles in 1908 and 6,146,617 in 1918. While in 1908, a motor truck was rarely seen on American highways, in 1918 not less than 600,000 were in use in the United States, motor trucks constituting from 10 to 20 per cent. of the registered motor vehicles in the several States. Highway improvement has not kept pace with the increase in the utilization of motor vehicles. The fundamental basic axiom that economic highway transport is impossible without good roads should be fully recognized. A review of the present status of highway improvement in the United States indicates that there are about 2,500,000 miles of rural highways; that 12 per cent. are classified as improved; and that about one-fourth of one per cent. are suitable for trunk highway motor truck traffic.

In England the Roads Were Ready

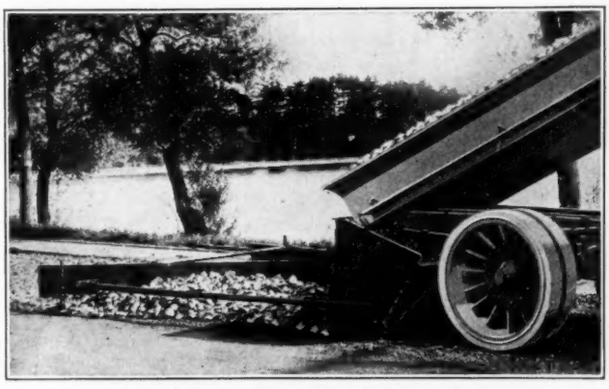
In England, the improvement of the main county roads preceded the development of highway transport. When transportation of heavy loads of commodities over highways was inaugurated prior to 1890, England did not have to wait for the construction of highway systems with the result that rapid growth of highway transport took place. It is not surprising, therefore, that English highway transport methods had reached the same stage of development in 1909 which exists in the United States in 1919.

England Has Solved Problems Now Engaging Our Attention

The writer had the opportunity of investigating highway transport in England in 1909 and 1910 and found, at that time, the same problems with reference to development of highway transportation and legislation that exist in this country today. As early as 1891, Fletcher, in writing on "Transportation on Common Roads," considered some of the classes of highway transport now under discussion in the United States and cited

"I would not try to Build a Road without the BURCH STONE SPREADER

It will pay for itself in every half mile of road." Says Fred M. Mark, of Mark & Van Gundy, Road Contractors, Washington Court House, Ohio.



Burch Stone Spreader in Operation.

It is such indorsements as this that make it easy to sell these **Burch Stone Spreaders** to road contractors.

The Spreader can be attached to any motor truck. It soon pays for itself in saving labor and material. It practically eliminates labor and entirely eliminates rehauling and shoveling. It conserves stone by keeping the thickness uniform as specified.

Get prices and full particulars from

THE BURCH PLOW WORKS CO., Department A Crestline, Ohio.

many instances of conflict between highway authorities and highway transport interests regarding some of the fundamentals of highway design. Pratt in 1912, treating of the subject of inland transport in England presents many phases of the problem now confronting us with reference to what he calls "Back to the Land Movement." In 1910, Henry B. Drowne and the writer prepared a paper on "English and American Highway Traffic Regulations" in which the English traffic laws of 1896 and 1903 were referred to with special reference to weights, speed and dimensions of motor vehicles and trailers. A thorough study of the development of highway transport and legislation in England would be of material benefit to many in the United States who seem to be of the opinion that they are treading on virgin soil.

The human, economic and social forces working for the improvement of highways and motor transport development in the United States are of such powerful character that nothing can permanently restrict progress in the construction of good roads and the growth of highway transport. Through no other agencies is it practicable to stabilize urban and rural development, to appreciably reduce the high cost of living as far as food stuffs are concerned, to bring the producer and consumer into close contact, and to solve some of the vital labor problems.

Highway Transport Engineering a New Technical Field

The development of highway transportation creates a demand for men having knowledge of and trained in a new technical field, which may be designated HIGHWAY TRANSPORT ENGINEERING. Fundamentally, this branch of engineering deals with the science, art, economics and business of highway transportation of passengers and commodities. In the opinion of some, highway transport may not be considered as belonging to the field of technical training and education. On sober thought, however, it will be seen that this branch of knowledge comes well within the classic definition of engineering embodied in the Royal Charter of the Institution of Civil Engineers of Great Britain, which, in part, is as follows: "The art of directing the great sources of power in nature for the use and convenience of man as the means of production and of traffic in states both for external and internal trade."

Breadth of Knowledge Essential

The breadth of training for this branch of engineering should be far more comprehensive than has been considered essential for many technical branches. Breadth of knowledge is essential, as the highway transport engineer must, in many fields, deal with social and economic conditions and must always have before him the fundamentals of sound business methods.

Comprehensive courses in highway transport engineering to be offered by educational institutions should include the following basic fundamental subjects: Economics, political economy, social science, business and contract law, scientific management, business organization, cost accounting, interstate commerce, marketing and distributing systems.

Subjects the Highway Transport Engineer Should Know

The highway transport engineer or manager should have a knowledge of all of the following special subjects:

History of American transportation and rural development. English highway transport methods and legislation. Interrelationship of highway, railway and waterway transportation including: Influencing factors of distances, rates, kinds of freight, equipment. Port, terminal and warehouse facilities. Interrelationship of highway transport, good roads and rural development. "Back to the Farm" movement, which is a function of three fundamentals, namely, building of systems of good roads, utilization of highway transport, and establishment of economic distribution from producer to consumer.

American highway traffic legislation: National, state, county, township and municipal laws, licenses, taxes and traffic regulations, especially those covering speeds, weights and dimensions of motor trucks, trailers and motor busses.

Fundamentals of highway engineering affecting economic highway transport including: Administration of highway departments; highway systems; location, drainage, foundations, grades, curves, widths and shoulders of highways; characteristics of different kinds of roadway with particular reference to traction; snow removal; guard rails, culverts and bridges; highway signs.

American highway transport methods: Comparison of horse and motor transport, municipal haulage, municipal delivery systems, store door delivery, inter-city haulage, long and short haulage outside of cities, rural motor express, return loads bureaus, motor truck parcel post, plant and factory haulage, army transport methods, horse transportation methods. Efficient methods of packing, handling, loading and unloading raw and manufactured materials. Highway transport management. Fundamentals of cost of highway transport. Cost and record systems. Organization of motor haulage companies. Labor for highway transport.

Motor truck, motor bus, tractor and trailer mechanism, operation, inspection, maintenance, repairs and cost data. Adaptability of different types of trucks and bodies. Disadvantages of overloading and overspeeding. Economic utilization of tractors and trailers. Garages. Accessories, such as tires, fuel, lubricants and mechanical devices.

Transportation surveys, being investigations of highway routes, highway transport legislation, traffic regulations, rural and urban transportation opportunities, competing carriers including railway, waterway and other highway transport facilities, and all other factors which may affect the transportation business which it is intended to establish.

Acknowledgment

The foregoing matter is the text of the Presidential address delivered by Mr. Blanchard at the annual meeting of the National Highway Traffic Association in New York City on May 14, 1919.

Good Roads and Rural Motor Express to Lower the Cost of Living

By F. W. Fenn, Secretary, Motor Truck Committee, National Automobile Chamber of Commerce

The greatest problem confronting us today, is the high cost of living, but we are fortunate in possessing two dominating factors, which if applied and applied in the right way, will tend to lower food cost to the place where it properly belongs. I refer to good roads and highway transportation. Highway transportation is already here, but, with the exception of a small percentage, our roads are not adequate for efficient haulage over them. To make this form of transportation efficient and economical we must have a solid road bed—heavy enough and firm enough to allow for speed and tonnage. You cannot have these if you are operating in mud. Mud retards progress, your operating costs increase and hence you are not able to give your patrons transportation at a figure which could be called economical nor can you expect to receive from your operation the profit which would come to you if the operation was on a solid base. Therefore, under these conditions you would not be doing much in the way of lowering food costs to the consumer. The consumer, as well as the producer (the farmer) should be as much interested in better roads as the operator who uses them for economy in this line will affect all.

Roads Must be Built for Truck Traffic

It has always been the practice to develop up to the existing demand. You would not build or make anything for which a demand did not exist. Taking the railroads as an example—development of load always preceded the development of the steel highway. In the early days wooden rails with iron bands were used because the traffic of the day did not demand more.

However, as trains grew in length cars became larger and locomotives became heavier, heavier rails were laid, ties were placed closer together, rock ballast was resorted to and stronger bridges built, the railroad had developed up to the demands which its tonnage was making upon its roadbed. Our tonnage for highway transportation is here and the most flexible machine in the world for hauling that tonnage is also, when we apply the motor truck, but the highway must be built to carry them. We must not build as we built to carry horses and wagons, for if we do we are not following natural laws, but are wasting our money and our efforts.

Rural Motor Express Now Operating in Every State

You are no doubt aware that the Rural Motor Express is even now ahead of highway development, for it is operating in every state and every community within our states, and its influence is being felt by the farmers, in increased production and bigger profits and by the consumer through larger supplies and ultimately lower costs. The Rural Motor Express had its birth with the war coming up in a time of need, when the world was calling for food and when we were paying a price that was staggering.

Roy D. Chapin as Chairman, R. C. Hargreaves as Secretary of the Highway Transport Committe of the Council of National Defense at Washington, originated the plan which was to reorganize the transportation system of America.

The National Automobile Chamber of Commerce, through its National Motor Truck Committee undertook the work of organization, co-operating with Mr. Chapin's Committee and now after a brief space of time we find this new form of transportation taking form in the way of hundreds upon hundreds of lines of Rural Motor Express which are opening up our waste places and bringing millions of acres of the most fertile soil into easy reach, so that the products raised thereon may be easily and economically brought out where we may have them for consumption.

Hon. John M. Baer of North Dakota in a speech in the House of Representatives stated: "A new and scientific method of marketing is a problem that surpasses every economic movement in its importance. Every plan to obtain for the farmer a greater share of what he produces and at the same time reduce the cost of living for the consumer demands the immediate attention and earnest consideration of every patriotic citizen."

Sixty-five Cents to Distributor and Only Thirty-five Cents to Producer

H. W. Collingwood, editor of the Rural New Yorker, who has made a life study of the subject of marketing, says that on a yearly average the farmer receives 35 cts. for his products which cost the consumer $1. This authority is supported by another eminent expert, John Dillon, head of the Bureau of Foods and Markets of New York City, who declares that the ultimate consumer pays two-thirds of his dollar to the system of distribution. In other words, it costs a minimum of 65 cts. to handle 35 cts. worth of foodstuffs.

It is unnecessary to quote experts on the subject. Did not Mayor Shank, of Indianapolis, recently go to Grand Rapids and buy several carloads of potatoes at 50 cts. per bushel from jobbers—the farmers received 40 cts.; and did he not sell them in his city for 75 cts. per bushel when they were costing the consumer $2 per bushel in that city? He handled potatoes for 35 cts. which the profiteers got $1.50 for handling.

The Report of the California Fruit Growers' Association show that the grower received on an average for the past four years $1.60 per crate for oranges, while during the same period the consumer paid an average of $4.80. In New York City people pay 14 cts. a quart for milk which the farmer receives 5½ cts. In South Bend, Ind., while the farmer, 135 miles away, received 60 cts. per bushel for tomatoes, they were selling for $3 per bushel. A farmer gets 20 cts. a pound for cotton. We must pay $2.56 for that pound of cotton when woven. For

Cuts Expenditure of Time and Money in Half

A saving of 50 per cent in Wages and Time is credited to the **Heltzel "Lightning" Loader** by William G. Tonkel, County Highway Superintendent of Allen County, Fort Wayne, Indiana.

By installing two "Lightning" Loaders he was able to dispense with five men. He found he could load a 2½-ton truck in 30 seconds. On the work in question the loaders so speeded up operations as to make one truck do the work of two.

This is a record of performance to command the attention of all.

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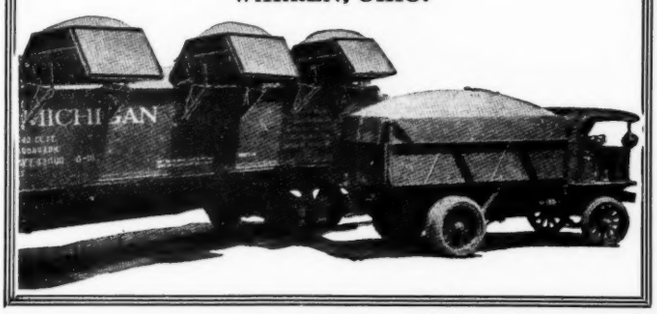
WARREN, OHIO.



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Embodying only such units of construction that have been approved by the greatest engineers of the industry—like Continental Motor, Timken Axle and Bearings, Cotta Transmission.

Performance Records prove Acme to be the best truck for Municipal and County Service

ACME MOTOR TRUCK CO.

1, 2, 3½ and 5-ton Models

ACME

430 Mitchell St. CADILLAC, MICH.

a pair of shoes selling at $8, the farmer gets 75 cts. for the leather and labor gets 45 cts.

The farmer sells his wool for 60 cts. a pound. We must pay $4.75 for that pound of wool when bought as yarn. In Fargo, N. Dak., when the farmer was getting 60 cts. for his wool, yarn was selling at $2.50—yarn spun at very little cost. Later, when the War Industries Board fixed the price of wool at 57 cts., yarn sold at $4.75. The price of the raw material was fixed; the price of the finished product was not. Through these wasteful methods of handling it cost from $2 to $5 to deliver $1 worth of food. Stated in terms of man power, it takes from 2 to 5 men to handle a one-man product.

Getting Results at Washington, D. C.

Among the many proposals that have been made to develop an efficient system of exchange between the farm and table is the postal market or Federal food exchange. At Washington, D. C., the plan is being worked out. The Government is using some of the thousands of motor trucks which will soon be released from the National Army. Community centers are being established, and there is the closest co-operation between the farmer and buyer. All unnecessary distributing agencies are eliminated. Instead of costing from $2 to $5 to deliver $1 in products, it costs only 10 to 15 cts. It is a complete reversal of the inefficient methods of the past. This is one real remedy which rings true with definite results.

Remarkable Advance in 12 months

I am going to tell you of the remarkable advance that has been made in a period of 12 months, as I have seen it. Operating out of Cleveland, Ohio, the Highways Motor Transport Company has been making quite a showing and has been responsible for greater production because this line has interested the farmer to the extent that he has given more attention to greater production. Large 6-ton trucks and trailers are being used. During the last summer this company made a remarkable record in hauling hot-house vegetables from Geneva and Ashtabula to Cleveland. When fruits and vegetables began to come into the market 20,000 thousand crates of berries and 25,000 bushels of tomatoes were hauled to the Cleveland markets. These shipments were followed by 20,000 bushels of apples, peaches and beans. You know what we have paid for apples in New York City—from 10 to 15 cts. We are doing it because we have failed to realize that the finest apples in the world are grown in Connecticut and northern New York —and so, of course, we are buying apples which come 3,000 miles from Oregon and Washington. Just think what the cost of apples would be if we could bring them in from Connecticut in motor trucks—of the great quantities which could come in, so that you and I could occasionally eat an apple without feeling guilty. With this lower cost and greater consumption the merchant would still make more because of the added consumption. We are doing ourselves a great deal of harm when we permit apples to rot in New England and show a willingness to pay for a product which carries with it a long haulage cost. This same company hauled 84,000 baskets of grapes into Cleveland last summer. Trailer trains were also used and to show you the economy of this kind of an operation 230 bushels of tomatoes were hauled on the trailer while the truck carried 291 bushels of tomatoes, 9 bushels of cucumbers, 80 baskets of peaches and 13 cans of cottage cheese.

Another line operating over the Alleghany mountains from Johnstown, Pa., hauled 115 bushels of potatoes to the load in three hours. The distance of this route is 35 miles. About four months ago I learned that the farmers on Long Island were intensly interested in rural express so J. Kent Warden started out operating 2 5-ton trucks. Today he is operating 8 5-ton units. When Mr. Warden started he had a small shipping station on Greenwich Avenue but growth of his business has been so fast that he has had to abandon this station and now has a large receiving station at West End Avenue and 64th Street, under a 4-year lease. He also maintains a central station in Long Island City. Mr. Warden operates, running out, along the South Shore as far as East Hampton. He carries everything that the people in these villages require including full loads of dressed beef for the markets. On his return trip, along the North Shore, starting from Huntington he brings in full loads of everything that the island produces including oysters and fish. This line has been hauling oysters and has netted Mr. Warden $100 a day profit. Plans are practically completed for Mr. Warden to haul fish and he estimates that he will receive for shipment to New York from 500 to 600 barrels of fish per night. This is all remarkable when you consider that this line has developed over a period of only four months, and it is especially so when you consider that Mr. Warden's first load gave him a return of about $8 gross, whereas it cost him to run his truck in the neighborhood of $30.

Lines are running out of Philadelphia, out of McConnollsville and into and out of Pittsburgh. The progress was so rapid that it was hard to keep pace with it. The Omaha stock yard figures in the haulage of live stock which were published the first of the year have been very interesting. The facts revealed that a greater part of the 250,000 animals delivered from the farms within a radius of 75 miles of the stockyards came in by motor truck.

From Steamboats to Railroads to Trucks

"A 100 mile Truck Line between Portland and Salem with stops at farms and towns en route." In the seventies Captain Hugh B. Scott began the operation of a light draft steamer on the Williamette River between Portland and Salem. This was very much a business venture in those days and few people believed the line would succeed. But it did. The steamboat line was a success for a time but the Southern Pacific Railroad furnished speedier transportation between these two points which almost wholly replaced the slower steamboats some years later. However, short haul lines are not profitable to the railroads, and the 55 miles between Portland and Salem is in this short haul class. It is on such hauls that motor trucks are demonstrating their value. Such a motor truck line, the Highway Rapid Transit, has been in operation several months and strange to say E. B. Scott, the son of Captain H. B. Scott, is the man who first put on a fleet of trucks just as his father first turned to steamboats.

Three Federals are in use, two of 3½ tons and a two tonner, the heavy trucks making a round trip every 24 hours, thus giving day and night service. The two tonner makes the round trip only on rush days, being used mostly on pick-up and delivery work at Portland. The company contemplates putting on one-tonners at each end for pick-up work, and using the two tonner on regular schedule. The freight rate ranges from 30c to 40c per 100 lbs. The line has had so much business that 5 tons have been carried every trip. The main difficulty just now is some 20 miles of rather rough, and mud roads that mean slow going and some delay. This stretch lengthens the time to about nine hours for the 55 mile trip on way. However considering all necessary stops, this 110 miles every 24 hours is very good time. When the character of the country through which the line passes is understood, the value of the service is even more apparent. The entire route over the Pacific Highway, is well settled, most of the land being fertile agricultural land. From these farms, milk, butter, eggs, poultry, veal, hogs and vegetables are sent into market. The night truck brings in most of the farm products arriving at best time to market such produce and bringing it in better condition. The line has increased the production of farm produce by furnishing better marketing facilities. It enables the farmer to dispose of small lots of produce, milk or eggs, which would otherwise never reach the market. This increases the farmers output and profits and because of added supply, will tend to reduce prices to consumer. The line also cuts out middlemen, as the farmer can send direct to the market.

Facts and Figures are Solicited

for publication in the ***Motor Truck Section*** of MUNICIPAL AND COUNTY ENGINEERING on the performance of motor trucks, with or without special equipment, in the public works field.

What character of service have trucks rendered in your organization? How has the cost of motor haulage compared with the cost of horse haulage, according to your observation? What are the factors controlling the limits of economical motor haulage, as you have observed them?

Readers are invited to submit for publication cost data on motor haulage in various kinds of public works activities. Actual cost data are requested; estimates of cost are not wanted.

Truck users will be compensated for submitting specific information of this character.

Municipal and County Engineering

538 S. Clark Street CHICAGO

This is indeed a practical application of the principles of the Rural Motor Express as advocated by the Highways Transport Committee.

Other Specific Examples

Down in Dallas, Texas, W. F. Brittson is operating a Rural Express train. His trucks go out hauling four trailers to Farmersville, Texas. A load consisted of 70 head of sheep and 17 head of steers, net weight of load 29,500 lbs.; the distance traveled with this load was 90 miles, 22 miles of which was over black land roads.

In Harford County, Maryland, the railway service was so unsatisfactory that rural motor express routes were laid out and finally operated. The Harford Co-Operative Association first operated between Bel Air and Churchville and Baltimore, hauling milk, cream and other farm produce to the city and food stuff, seeds, salt, fertilizer, machinery and supplies for the rural merchants on the return trip. As soon as the project was well under way a central receiving station was established in Baltimore for the reception and centralization of the supplies to be returned to the country. No attempt has been made by the association to earn dividends. Rates are made with a view of meeting the expenses, providing for depreciation, and accumulating a surplus to be used as working capital The rate on goods classified as first class and inclusive of apples, axle grease, baskets, butter, beans, buckets, buckwheat, barley, empty barrels, blankets, blacking, canned goods, coffee, cabbages, cantaloupes, fish, groceries, hardware, dressed hogs, harness, hay, iron, molasses, machinery under 400 lbs., notions, oils, onions, oranges, potatoes, dressed poultry, stoves, auto tires, vegetables, and automobile, auto truck, buggy, and wagon wheels, is 15 cts. a hundredweight, while second-class articles such as axes are hauled for 12 cts. a hundred pounds. Calves are transported to market for 50 cts. a piece, while live cattle and hogs are handled at 50 cts. a hundredweight. It costs 25 cts. a coop to ship chickens, while cream and milk are hauled at 2½ cts. a gallon, the empty cans being returned. The Harford Co-Operative Association has fulfilled the purpose for which it was organized. It provides satisfactory transportation services at lower rates than the local railroad customarily charges, while the convenience of the farm pick-up service is very pleasing to the farmers. For the hauling of milk and cream, which constitutes the bulk of the business of the Harford Association, the truck system provides superior facilities to those furnished by rail, especially in that it minimizes the damages and loss of milk cans which, in the instance of railroad transportation, usually represents a heavy outlay.

A line running between Denver, and Evergreen, Colo., carries milk and other food products to market; there is one running from Redding to Cedarville, Colo., 52 miles over mountains. It makes the round trip at a total cost of $25 in 11 hours. It has taken the place of an 8-horse team, which took 7 days to make the round trip at a cost of $14 a day, total $98.

The above are a few instances which will show how economical and profitable a Rural Express can be under the right kind of management. New lines are coming into existence daily in great numbers. The Highways Transport Committee of Iowa reports that one company at Sioux City is starting with 50 trucks, which it states, are in a class by themselves. Farm hauling may not be called rural express, but it is pretty close to it.

What Motor Trucks Are Doing for Farmers

The use of motor trucks with the farmer might be said to be developing just as rapidly as the farmer is learning to think in terms of road mileage. When he ceases to think of transportation wholly in terms of horse power and can comprehend the cost a mile a pound regardless of the power used, then the sale of motor trucks will be tremendous. However, trucks are being used to replace railway service or rather extending the farmer marketing radius and bringing the distant city markets within hauling distance of his farm. So we may say that while the truck is being introduced largely because it offers cheaper hauling than with horses, yet a factor almost as important is its ability to do things that are entirely beyond the range of the horse. Probably the best illustration of the latter is the hauling of livestock from the farms to the large packing centers.

Hauling Livestock in Trucks

"Motor Trucks," says E. M. Carroll, Traffic Manager of the St. Joseph Stock Yards Company, "are being used here to a large extent. We have had truck loads in here from as far east as Chillicothe, Mo., a distance of about 85 miles by rail. We also have received livestock by truck from across the Iowa line, a distance of from 70 to 80 miles. There are trucks making regular trips to the market from points as far as 65 to 70 miles distant. These trucks not only haul hogs, but they also bring cattle, calves and sheep and very frequently they bring in mixed loads, separated by partitions. Our largest day's receipts from this source were slightly more than 1,400 hogs and nearly 200 head of cattle and calves and 200 sheep. We did not count the vehicles employed to bring this stock to market, but we estimate that there were close to 250 trucks and wagons, of which 75 per cent. were trucks. "For the 9 months ending Sept. 30, we received from this source 75,211 hogs; for the same period in 1917 we received 33,286; for the entire year of 1917, 56,529, while in 1916 our receipts were 52,048. For 24 days of October this year we received 11,622 cattle, 418 calves, 16,150 hogs, and 25,922 sheep; for the entire month of October 1917, we received 801 cattle, 877 calves, 5,834 hogs and 1,607 sheep. Most of the trucks employed in bringing stock to market are engaged in this business regularly and they range from small trailers attached to the rear end of passenger vehicles to 4 and 5 ton trucks. These larger trucks have a capacity of as much as one-third of a regular railroad car of stock. Many of these trucks are able to get a return load, especially those that come from or pass through inland towns or towns not located on railroads. Some of these trucks are owned and operated by regular dealers located in the country, but the majority of them simply are engaged in transporting live stock and make a charge of so much a head or load. We believe that this movement is permanent and are going to increase our facilities for taking care of it."

Motor Truck Routes to Replace Branch Line Railways

Highway haulage is making a large place for itself in the reconstructed transportation system of our country and Charles A. Morse, Assistant Director of Operation in charge of Engineering and Maintainance, United States Railroad Administration, in a recent speech, told the New York Railroad Club that motor truck routes are to substitute railway branch lines. Congressman Baer of North Dakota states that the motor truck is a carrier which seems to be the most feasible and practical of any for solving our National problems of today. Canada is also turning to it; in a letter we have received from S. J. McLean, Commissioner, Board of Railway Commissioners for Canada, at Ottawa, he states "I am very much interested in the question of improved utilization of highways in the carriage of traffic." In old England we find that the development of the motor lorry services has been a tremendous boon to commerce and surburban sections.

The coming of highway motor transportation means that a greater day is breaking, and that a greater United States is in the making for truck lines reach out everywhere and anywhere under the sun and bring our commerce into real competition with the world.

Acknowledgment

The foregoing paper by Mr. Fenn was presented at the annual meeting of the National Highway Traffic Association held in New York City on May 14,1919.

EDITORIALS

Publicity for Municipal and County Engineers

Municipal and county engineers can greatly increase their influence and the security of their positions by the proper use of dignified publicity methods. Engineers of all classes profit greatly from proper publicity. The engineer who complains that his work is not appreciated by the public is quite likely to boast that he "does not believe in advertising himself." He should realize that the public is not to be blamed for ignorance of his work if he keeps silent about it. It is because of his silence that politicians frequently appropriate the credit that properly belongs to the engineer.

Few engineers like to speak in public, but those who do can make known the interesting features of their work by addressing all sorts of local organizations. This method has the added advantage of personal contact, and gives the engineer of forceful personality the best opportunity to assert himself as a leader in his community.

Those who do not show to their best advantage as public speakers should write of their work. Local newspaper editors, as a rule, are very glad to publish illustrated descriptions of new engineering works, and are even willing to give space to discussions of matters of public policy on which the engineer is especially well qualified to express an opinion. The engineer who does not write of his work for his local papers neglects his best opportunity to exert the influence in his community that he knows he should have. If he keeps the public informed he will find staunch defenders among influential men of all classes. He can acquire a character of support that will make it inexpedient for his non-technical superiors to ignore his recommendations on technical matters.

Local and national publicity are easily linked together and the latter greatly reinforces the former. Many times during the writer's experience as an editor he has published articles, written by city engineers, in this and other engineering magazines of national circulation. Following publication in the national medium marked copies have been sent to the editors of newspapers in the contributor's home city, with a letter advising that if proper credit is given the newspapers are at liberty to reproduce the article in full. When the original article is illustrated the cuts are loaned to the newspaper free of charge. This plan gives the local newspaper an illustrated article of local interest which the local editor is pleased to use if it is not too technical in character and contains news value.

Municipal and County Engineering is ready at all times to extend this form of co-operation to its engineer readers who are in the public service. There is nothing novel in the suggestion. It has often been done with benefit to all parties and harm to none.

It is obvious that the publication of an article by a city or county engineer in a journal of national circulation adds greatly to the engineer's prestige at home when the article is subsequently reprinted in the local papers with credit to the author and the national engineering journal in which it appeared. The fact that the article was accepted for publication by the journal of national circulation is assigned more weight than it deserves, perhaps, but the fact remains that this is construed as an indorsement of the professional attainments of the engineer and unquestionably adds greatly to his influence in his home community. Engineers are invited to contribute articles pertaining to their work, with these, as well as other, considerations in mind.

The Engineer and Construction Equipment

Except where construction work is carried on by day labor, the direct purchase of construction equipment by the engineer is rare, but it is a fundamental, and common, error to assume from this that the engineer is without influence in the purchase of machinery used on contract jobs and paid for by contractors. On contract work the engineer, if sure of himself, very often rises superior to the role of referee between the owner and the contractor. He becomes the adviser of the contractor in the interest of the contractor as well as in the interest of the owner.

The right-minded engineer does not want to see the contractor lose money. It is not enough that the owner should be protected in securing full value for his money, but the contractor is also entitled to a fair profit on every job. Assuming that the bid is high enough to make a profit possible, it certainly is a right and legitimate function of the engineer to help the contractor realize the profit.

The engineer is not likely to attempt to run the contractor's business for him. Such an attitude is indefensible and would draw a quick and stern rebuke. But the engineer can make friendly suggestions on many points which do not affect the quality of the work, but do affect the contractor's profits. The engineer has the advantage of perspective from his comparatively detached viewpoint. He gets a clearer view of some things than the contractor himself. In such matters it is well within the province of the engineer to counsel with the contractor.

Even where the contract and specifications do not give the engineer any authority with reference to the equipment used on the job, he very frequently can render a great service to the contractor by suggesting the use of additional construction plant units. Many engineers are close students of plant selection and performance and are well qualified to advise with contractors in this matter. The giving of such advice is recommended because it is thought to be in the best interest of all parties.

Intolerance

We believe that the salaried engineers of this country are rapidly making up their minds to take such steps as may be found necessary to improve their economic position. Undoubtedly many are still holding back, waiting for something to happen—a miracle perhaps. But the majority of engineers on salaries are rapidly acquiring a very wholesome determination to look out for their own kind while "pushing the world up hill" and "planting a flower in the other man's garden."

Various measures calculated to safeguard the engineer and to increase his earnings have been under discussion for several years. There are both national and local organizations laboring to achieve these ends.

It is only natural that there should be various remedies prescribed and various doctors to administer the remedies. Now there is nothing more natural than that doctors should disagree, but they do not need to get violent about it.

We hope that as this movement gains momentum the various schools of thought will not adopt intolerant attitudes toward each other. If they do, the engineer will be set back a few more decades. It is too early for any man, or any group of men, to say that certain measures and certain forms of organization are the only ones that promise success. Until the end of our labors for the engineer comes clearly into view let us adopt a tolerant attitude as between the advocates of the various plans and proposals brought forward to assist him. The spirit of intolerance, if allowed to come in, or to stay in, will defeat the efforts of all.

Municipal Engineers Are Interested

Municipal engineers are interested in the movement now under way to increase their compensation and the security of their positions. There are many evidences of this, one of the most significant being the request for a large number of copies of the June number of this publication for distribution in an important city where this question is being agitated at this time. That particular number contained an unusual amount of matter useful to municipal engineers in this connection.

It is a hopeful sign that engineers are at last genuinely interested in their own welfare and are emerging from the conversational stage to the stage of action. Municipal engineers, and other engineers in the public service, should give special attention to their economic status during the present year while they have the advantage of organization help from the American Association of Engineers.

The Engineer and Overtime

In the hearing on the pay of professional engineers in railway service, before the Board of Wages and Working Conditions, United States Railroad Administration, held March 31-April 2 of this year, in Washington, the testimony of all engineer witnesses, whether called by the American Association of Engineers or not, was against overtime pay for engineers. This fact should be somewhat reassuring to those who feel that the engineering profession is being trade-unionized.

The demand for payment for overtime work is probably the one thing more than any other that has tended to prejudice the general public against trade-unionism. Most people work overtime occasionally, or frequently, or habitually, and do not seek extra compensation for doing so. The farmer and the business man alike work long hours, and it has ever been a characteristic of the engineer that he is not a clock watcher. He is still willing to work very long hours, it seems, when work is heavy, and he does not ask extra pay for it. What he does seek is better compensation from month to month, not from hour to hour. The average salaried engineer is just as willing as ever to work from 8 to 12 hours a day, and even longer, if need be, without any thought of "time and a half for overtime," but he is no longer willing to work month after month for all sorts of hours, in all sorts of places, for his board and the glory of service—and to get experience.

Fees, Salaries, Wages

In the discussions of engineers' compensation, now receiving so much attention, it is to be hoped that there will be no bad feeling engendered between engineers who work for fees and those who work for wages. It is well to recognize the possibility of such ill feeling sufficiently far in advance to prevent its becoming an accomplished fact.

Engineers who work for fees have a tendency to look with disfavor on the movement to increase the salaries of engineers. One reason for this is that fee engineers usually are employers of salaried engineers. They have the natural disinclination of all employers to increase wages. With this attitude we have scant sympathy, for the engineer who works for a fee can increase his fee with a great deal less trouble than is experienced by the salaried man in living on his same old salary in these days of inflation. If the great mass of salaried engineers can succeed in getting their compensation increased, surely the much smaller group of vastly more experienced and more influential men who work for fees should do proportionately as well.

Another reason why the fee engineers look with disfavor on organized efforts to increase salaries is that they fear the lowering of the profession to the level of a trade. This is rather a complex matter. Perhaps to some engineers engineering is a profession and to others a trade. The engineer who works for a fee is undoubtedly a professional man, but there are many who assert that the wage-earning engineer is not. There was a time when the fee engineers were relatively more numerous than at present. Then they were the leaders in thought in all matters pertaining to engineers and engineering. They established certain guiding principles for engineers, designed to serve the needs of the fee engineer, and it is the inability of the modern salaried engineer to follow these guiding principles and live comfortably at the same time that has at length caused him to think less of words and traditions and more of increased compensation. So long as nothing is done to injure the public we do not see that the fee engineers need be overconcerned about the efforts of the salaried men to secure a fair wage.

Any bad feeling between fee and salaried engineers would be most unseemly and should be avoided. Each class needs the other. There can be no real conflict of interests between them.

Speaking of words, as we were a moment ago, it was once our privilege to hear an address by Theodore Roosevelt. It was a fine speech, of course, but we long ago forgot what it was all about. Only one sentence in the address has embedded itself in memory. Here it is: "It is better to work for $20 a week in wages than $12 a week in salary."

A Slander on New Mexico?

The Federal State Director of the U. S. Employment Service for the State of New Mexico recently sent out a letter to military camps about employment conditions in that state. Here is the introductory paragraph: "In case any men from the State of New Mexico are stationed at the camp where you are making your headquarters, we ask that you call their attention to the fact that there are very few opportunities to secure employment in this state at the present time." Then follows a polite hint that the young men who were good enough to fill New Mexico's military quota go to some other state for jobs. Fine business! This should help greatly in the recruiting for the next war

Some Broader Aspects of Rain Intensities in Relation to Storm Sewer Design

By Robert E. Horton, Hydraulic Engineer, 57 N. Pine Ave., Albany, N. Y.

(Copyright, 1919, by Robert E. Horton.)

(Concluded from June Number.)

Mechanism of Thunderstorm Rain Intensities—Simpson's Theory of the Thunderstorm—Suspension Storage

The primary requisite for thunderstorms is a violent uprush of moisture-laden air. This condition may be induced by the warming of the air near the ground abnormally on a calm, clear day, thereby producing a buoyant instability. Days favorable to thunderstorms are likely to occur during the passage of the center of a low-pressure area over a region. Convectional thunderstorm conditions are most likely to occur where the topography favors the formation of a moist, stagnant layer of overheated air near the ground surface, as, for example, over a sandy plain, or sometimes over a shallow lake. Oftentimes some outside impetus is required to start the convective action with sufficient strength to produce a thunderstorm.

The advance of a low-pressure area, especially under conditions where there is a barometric trough or "squeeze" with a marked wind shift line, is very likely to supply the necessary additional condition.

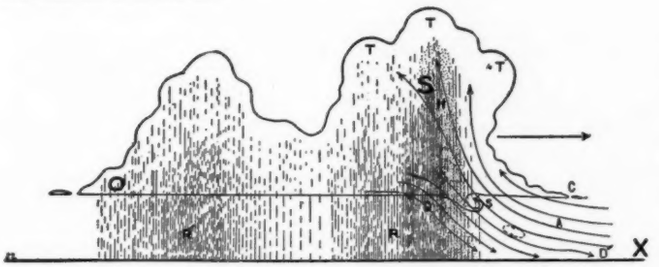


FIG. 6. IDEAL CROSS SECTION OF A TYPICAL THUNDERSTORM.

A, Ascending Air; D, Descending Air; C, Storm Collar (Sturmkragen); S, Roll Scud; D Prime, Wind Gust; H, Hail; T, Thunderheads; R, Primary Rain; R Prime, Secondary Rain; S, Region of Suspension Storage. (After W. J. Humphreys, Monthly Weather Review, June, 1914.)

It follows that as a cyclonic storm traverses the country, thunderstorms will develop in conjunction with it in regions where the advancing cyclone finds the conditions most favorable.

The facts cited above suggest an inquiry as to the special mechanism of the thunderstorm which produces these high rain intensities. Some years ago Lenard discovered that electricity is released when water droplets are broken up by an air current; this phenomenon may doubtless be explained in accordance with the modern electrical theory of matter. The application rather than the cause of this fact is of special interest here.

As the result of a remarkable field research in the Himalayas, Dr. Gilbert T. Walker, Meteorological Department of India, found that the known facts as to lightning are concordant with the theory that lightning is the result of the release or separation of electricity from rain drops in accordance with the Lenard effect, and to produce lightning in the high atmosphere requires that there shall be a mass of water droplets held in suspension or driven upward and broken apart by an ascending air current. That ascending air currents are a characteristic feature of thunderstorms is revealed in many ways.

(1) From the well-known convectional origin of such storms.

(2) From the observed form and nature of the cauliflower-headed cumulus clouds from which thunder and lightning emerge.

(3) From the observations of the few persons who have undergone and survived the thrilling experience of passing through the heart of a thunderstorm cloud in a balloon.

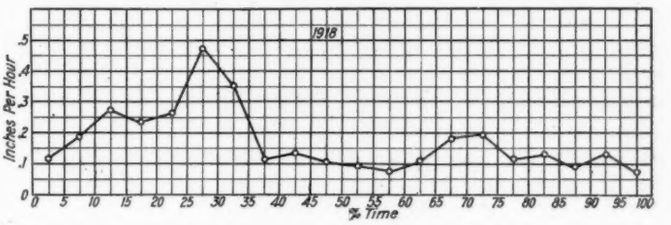


FIG. 7. THUNDERSTORM INTENSITY CURVE BASED ON 22 STORMS IN 1918.

Fig. 6 illustrates a typical longitudinal section of a thunderstorm.

The phenomena take place as though the observer was stationed at some point X, and the storm moved from left to right past him.

First consider the storm as if it were stationary. An uprush of air begins near the ground, at the storm front, as indicated by arrows. Rain is condensed above some level, oc, and all, or nearly all, the precipitation formed by the ascending gust is carried upward and held in suspension.

The rain condensed from and entrapped in the ascending air gust of a thunderstorm may descend slowly, or it may ascend, depending on the relation of the size of drops to the velocity of the ascending air current. The retarding of the rain tends to concentrate all the rain condensed over a given locality in a layer of air of much less thickness than the height of ascension of the gust which produces it, since most of the rain is condensed out relatively near the lower level of condensation.

When the storm front has passed the observer the suspended rain, no longer sustained by a sufficiently strong air current, rapidly descends, and it is undoubtedly the rapid precipitation of this suspended storage which produces the highest rain intensities for short durations. The larger drops will probably be mostly at lower levels in the suspension layer, and will also fall fastest and so reach the ground first. They will

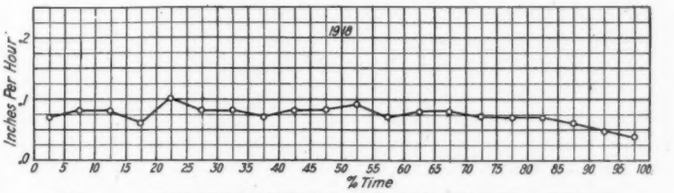


FIG. 8. NON-THUNDERSTORM INTENSITY CURVE BASED ON 80 STORMS IN 1918.

be mingled with a larger proportion of smaller drops as the rain continues, a fact observed by Bentley & Lenard. The supply of large drops may perhaps be replaced by coalition of smaller drops. The phenomena are complicated by violent eddy motions in the ascending current, and by the horizontal motion of translation of the storm bodily over or past the place of observation.

Apparently it is the breaking up of ascending raindrops in the formation of suspension storage which produces lightning, and the precipitation of this suspension storage plays an important role in relation to high rain intensities of short duration.

As a rule, the greater the temperature inversion by which a thunderstorm is constituted and sustained, the greater will be the force and thickness of the frontal convectional wind gust which produces the air current and suspension storage. The thicker and stronger the ascending wind gust, the higher the cumulus clouds will rise, and the thicker and denser will be the layer of rain suspension.

In violent thunderstorms, as suggested by Bentley, snow and hail may play an important part. The existence of either or both of these affects and probably increases the possibilities of suspension storage. A thunderstorm is often spoken of as "backing up." This is not really the case, however. A thunderstorm often travels in two sections, as indicated in the diagram, Fig. 6, and there may be a lull with only gentle precipitation between two periods of high rain intensity.

In the case of purely convective thunderstorms, where the rain is mostly produced from the air overlying the locality where the rain falls, or is derived from nearby localities, there

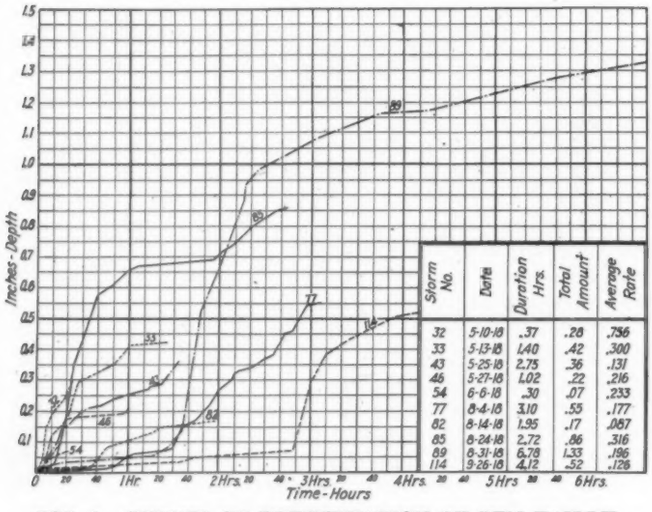


FIG. 9. CURVES OF PRECIPITATION OF TEN FAIRLY TYPICAL THUNDERSTORMS.

is a limit to the amount of precipitation which can be produced at a given place from a storm which travels progressively across the country. This limit is not far from the total amount of vapor contained in a column of air overlying the place where the rain falls. This amount is commonly 2 to 3 ins., but may be as great as 4 or 5 ins., in the case of warm, humid air. Greater amounts of precipitation must involve the transport of moisture from the surrounding regions. This condition not infrequently occurs where thunderstorms accompany cyclonic storms.

The important fact is that nature sets an approximate limit to the total amount of precipitation in purely local thunderstorms, while no such limit of amount exists in the case of cyclonic storms. A stalled cyclone, whose eastern advance is blocked by a high pressure area in front of it, may produce heavy rain more or less continuously for several days. Rain produced by the upward deflection of moisture-bearing wind against a mountain slope may continue as long as the wind lasts, as in the case of the winter monsoon rains, on the mountain slopes fronting the Bay of Bengal, in India. Even in such rains nature sets a limit to the intensity, which, although not definitely known or fixed, is apparently never exceeded in a given locality.

An attempt at explanation in full of the causes of the limitations of rain formation and intensity would lead us far afield in the mathematical phase of physical meteorology. The statements here made as to the meteorology of rain intensities are mainly intended to point out more salient features of the subject, and may appear unsatisfactory and incomplete to professional meteorologists.

Characteristics of Thunderstorm and Non-Thunderstorm Rain Intensities

The relation of rain intensities occurring in thunderstorms, or storms of a similar type, as compared with other storms, is illustrated by the following data and diagrams, obtained from a recording gage record of storms during the period April to October, inclusive, in the years 1917 and 1918, at the laboratory of the writer near Albany, N. Y.

Fig. 7 shows the average intensities in inches per hour of 22 thunderstorms in 1918. Fig. 8 shows the average intensity of 80 non-thunderstorms, recorded in the same season. The vertical scale for non-thunderstorms is twice that of thunderstorms, and the diagrams illustrate clearly the higher intensities which ordinarily prevail in thunderstorm rains. In general the intensity curve for non-thunderstorm rains resembles somewhat an arc of a parabola with a flat crown, a maximum occurring about one-fourth of the time from the beginning to the end of the storm.

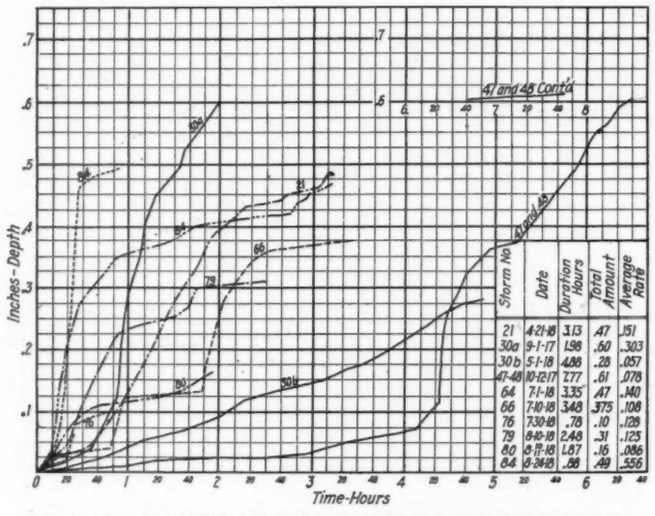


FIG. 10. GRAPHS OF TEN NON-THUNDERSTORMS OF THE THUNDERSTORM TYPE.

In the case of thunderstorms, the main maximum occurs after the lapse of 25 to 30 per cent. of the duration of the storm, and there is a secondary lower maximum at about 70 per cent. of the duration of the storm. This second maximum corresponds to what may be called the second section of a thunderstorm. It may be noted that the curves in Figs. 7 and 8 are plotted on the basis of a horizontal scale of time, expressed as a percentage of the total storm duration. In this way storms lasting only a few minutes are averaged in with others lasting several hours. The study of the rain intensity graphs in many thunderstorms indicates that this method of averaging will give more correctly the mean characteristics of thunderstorms than could be obtained by averaging the intensities occurring actually at corresponding times from the beginning of the storm. The reason for this is illustrated by Fig. 9, which shows the curves of precipitation of ten fairly typical thunderstorms. It will be noted that the graphs for typical thunderstorms are essentially similar geometrical figures. In other words, the graph of a heavy thunderstorm, if plotted on a reduced scale, may often be very nearly superimposed on the graph of a much lighter thunderstorm. The same phases occur in both, and the rain intensities during corresponding phases are similar, but the duration of each phase of a heavy thunderstorm, and consequently the total precipitation which it produces, is much greater than in the case of a light thun-

derstorm. This similarity in characteristics of light and heavy thunderstorms would be anticipated from a consideration of the mechanism of thunderstorm rain intensities.

It may be noted that about equally high intensities occur in short and long storms for short time intervals, but high intensities for long time intervals are of course wanting in the case of short storms. The relative frequency of equal intensities of different durations is apparently about proportional to the relative frequency of thunderstorms of different durations.

In general, each graph of a thunderstorm rain or of the portion relating to the first section of the thunderstorm may be considered as made of four phases: (1) The initial phase—this may start with a sudden dash of large drops and high intensity, but of extremely short duration, or the rain intensity may be moderate throughout this phase.

The second phase comprises the first long continued period of high intensity. The first phase may be wholly wanting, or may be merged into the second phase, in which case the storm starts with high intensity, which continues for some time.

The third phase is a period of very light intensity. This is usually of shorter duration than the other two phases. At the end of the third phase three things may happen: (a) The storm may end suddenly, or (b) there may be a short dash of rain of fairly high intensity, though commonly less than the second phase, or (c) there may be a second well-developed

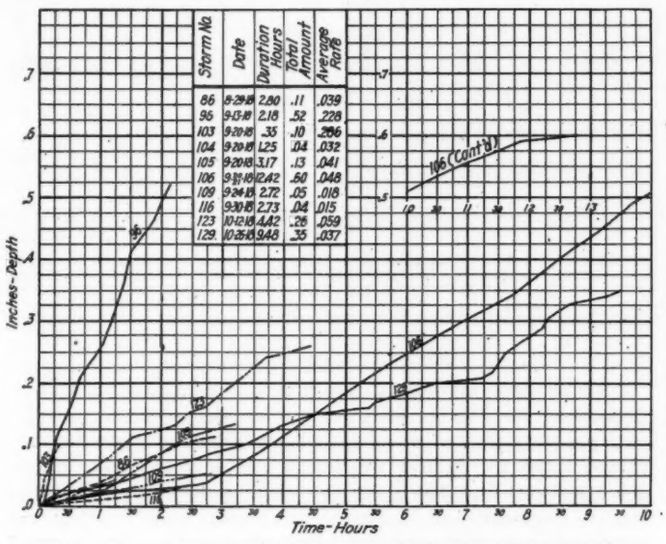


FIG. 11. RAIN GRAPHS OF TEN NON-THUNDERSTORMS OF THE LINEAR TYPE.

period of high intensity. This fourth phase of a thunderstorm, when present, comprises what is popularly referred to as the "clearing-up shower." Very commonly it marks the passing of the last portion of a thunderstorm, and is quickly followed by sunshine.

It is not infrequently the case that a second section of the storm follows the first, its first and second phases corresponding to the third and fourth phases of the first storm, with the latter continued. The second section is in all respects similar to the first, and its intense phase may develop equal intensity and duration to that of the first section. Inasmuch, however, as the second section is absent in probably three out of four cases, the average intensity in the second section, taking all storms together, is very much less than that in the first section of the storm.

Maximum rain intensities sometimes occur in non-thunderstorms. Non-thunderstorms may be classified as regards the rain intensities which they produce, and their distribution throughout the duration of the storm, as of two types: (1) Non-thunderstorms of the thunderstorm type. In Fig. 10 are shown the graphs of ten such storms, none of which were accompanied by thunder audible at the observing station. They occurred, however, under conditions generally favorable for thunderstorms, and some of them on days when there were thunderstorms at points not far distant. Very likely these storms were for the most part produced by convectional action, in a manner similar to the production of thunderstorms.

The second type of non-thunderstorms may be called the linear type, in that the graph of accumulated rainfall is in general approximately a straight line. Fig. 4 illustrates the rain graphs of ten non-thunderstorms of this type. Storms occur showing every possible graduation in type of graph, from the pure linear to the typical thunderstorm type, but well developed graphs of one or the other of these two types are more common.

It is true that thunderstorms having purely linear types of graphs, and those with intermediate types, also occur, but variations from type in the case of thunderstorms are much less common than in the case of non-thunderstorms.

The Inconstancy of Rainfall Rates; Rain Intensity in a Tropical Storm

One of the characteristics of rainfall is its lack of constancy. It is unusual for heavy rain to continue at a uniform rate for even as much as half an hour without interruption.

From a study of rain intensities in New York City for a period of 45 years, Hufeland (Engineering News, Sept. 7, 1916, page 454) found 280 cases where the average intensity

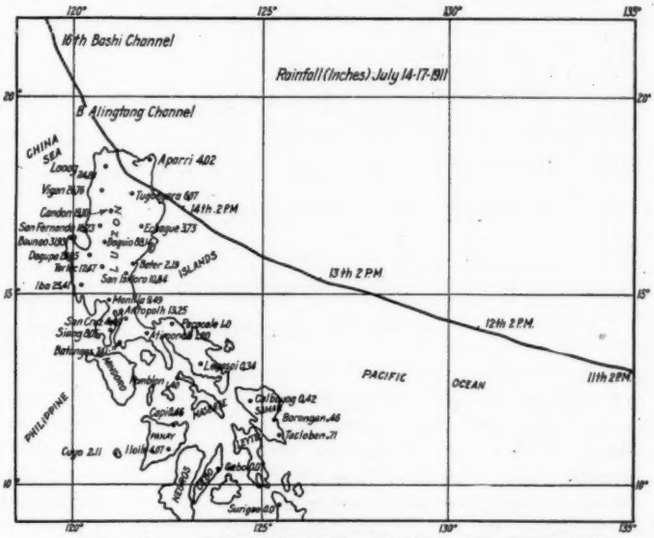


FIG. 12. APPROXIMATE TRACK OF TYPHOON, JULY 11-17, 1911, SHOWING RAINFALL IN INCHES JULY 14-17, 1911.

for 30 minutes' duration or over was excessive. Of these there were only 18 cases where the excessive rate was practically continuous and constant for 30 minutes or more, and only one case where there was a constant excessive rate for as much as 70 minutes.

Considering only periods of excessive intensity in which the rate was nearly uniform, Hufeland found that in 94 per cent. of the cases which occurred in New York City in the 45 year records, the duration did not exceed 25 minutes, and it exceeded 30 minutes in only 4 per cent. of the cases.

Figures 12, 13 and 14 illustrate the inconstancy of rainfall rates, even in the case of cyclonic storms of the greatest severity. This storm is remarkable in that it is probably the heaviest for which there is a continuous graphical record of the rainfall rate. Figure 12 shows the track of the storm. This occurred on July 14-17, 1911, and produced a total rainfall of 88.2 ins. at Baguio, on the Island of Luzon, in the Philippines, in four days.

Figure 13 shows a copy of the graphic record, for July 14 and 15, from the official report of the Philippine Weather Bureau. The zigzag lines in the lower diagram are the record from the Friez tipping bucket recording rain gage. Baguio

is located between Mt. St. Thomas and the west coast of Luzon.

The heavy rainfall was produced by wind from the China seas blowing eastward against and deflected upwards by the west slope of Mt. St. Thomas, which rises to an elevation of 7,530 ft. In order to show the fluctuation in rate of the rainfall during this storm, the rate for each 5-minute period for the 24 hours from noon, July 14, to noon, July 15, was computed from the recording gage record. The plotted results are shown on Fig. 14. Here, as in most intensive storms, the highest intensity occurred near the beginning of the storm, although there were numerous 5-minute periods in which nearly equal intensities occurred. It will be noted that an average rainfall rate of 1½ to 3 ins. per hour persisted continuously for 20 hours or more. The rain intensity fluctuated in periods of about 20 minutes from crest to crest. This fluctuation was undoubtedly due to gustiness of the wind, and is a feature common to intense rains in all localities.

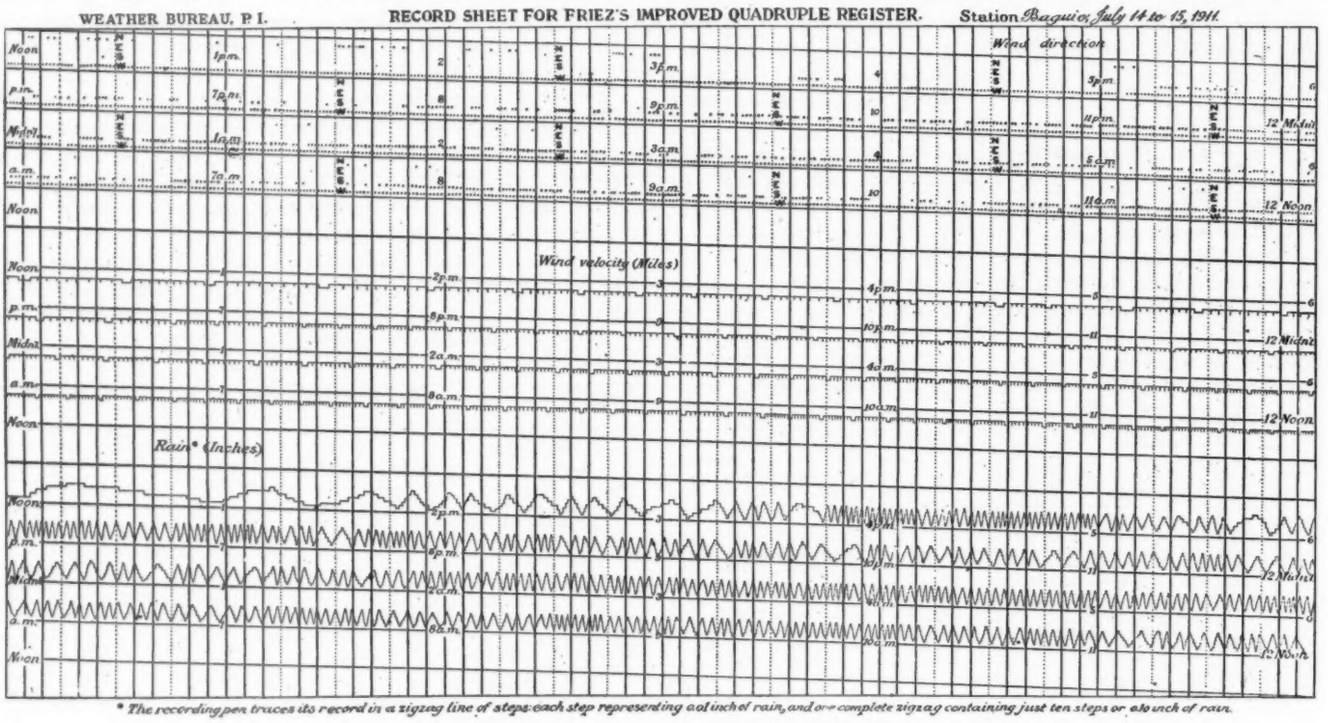

WEATHER BUREAU, P. I.
RECORD SHEET FOR FRIEZ'S IMPROVED QUADRUPLE REGISTER.
Station Baguio, July 14 to 15, 1911.
Wind direction
Wind velocity (Miles)
Rain* (Inches)
* The recording pen traces its record in a zigzag line of steps: each step representing .01 inch of rain, and one complete zigzag containing just ten steps or .10 inch of rain.

FIG. 13. RECORDING GAGE SHEET FOR BAGUIO STORM, JULY 14 TO 15, 1911.

The rain recorded is that caught by a rain gage with a horizontal funnel exposure. The rainfall was accompanied by a fairly constant wind, having a velocity of about 60 miles per hour. Assuming, for illustration, that one mile of wind velocity produces one degree in deflection of falling rain from a vertical line, and taking into account the abrupt west slope of Mt. St. Thomas, it is evident that the actual amount of rain interception on the west slope of the island per unit of projected or horizontal area must have been very materially greater than the amount indicated by the rain gage record.

The enormous rainfall of this storm was produced by long continuation of high rain intensity, yet the maximum intensity for short intervals was not greater than frequently occurs in regions where such storms are unknown.

The difference in rain intensities for short time intervals in different places appear to be more a matter of frequency than of amount. The records of rainfall of India contain about 2,800 instances of rainfalls of 10 ins. or more per 24 hours, yet, so far as can be ascertained without recording rain gage records, the intensities for intervals of 5 minutes to one hour are not often greater than those frequently experienced in the United States, although equal 24-hour rains are rare in this country.

New York Rain Intensities

In the older method of deriving a rain intensity curve as illustrated by Fig. 1, by drawing an approximate envelope of the points plotted on the diagram, practically all the data except those for higher intensities are disregarded—furthermore, as already pointed out, this method does not necessarily lead to homogeneous curves, that is to say, the resulting rain intensities for different durations shown by such a curve may not be of equi-frequent occurrence.

In order to illustrate the method of analysis and plotting of a record of rain intensities by which the resulting curves are not only homogeneous or equi-frequent throughout, but which correspond to a given or chosen exceedance interval, the records of rain intensity for a period of 45 years, taken at the City of New York, have been analyzed, and the results are summarized in Table III. In this table the first, second and third highest, etc., of the observed rain intensities for each of the time intervals indicated in column headings have been arranged in order of their magnitude. For intensities less than the ten highest the averages of groups of five successive values have been taken, and these are given in the table opposite the number corresponding to the order of magnitude of the median of the five values in each case.

The data in each column of the table corresponding to a

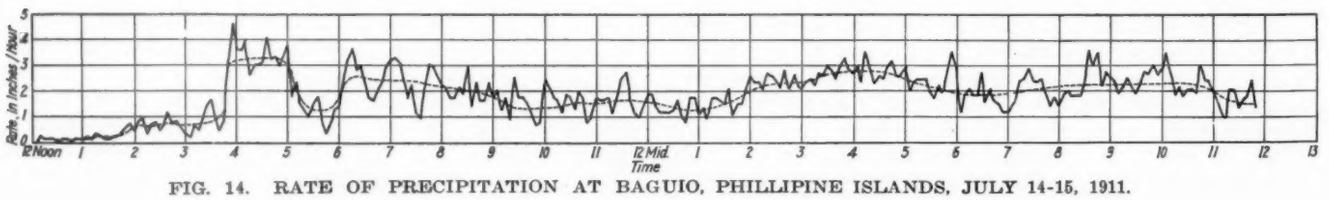


FIG. 14. RATE OF PRECIPITATION AT BAGUIO, PHILLIPINE ISLANDS, JULY 14-15, 1911.

TABLE NO. III—SUMMARY OF MAXIMUM AVERAGE RAIN INTENSITIES FOR SHORT INTERVALS AT NEW YORK CITY, 1869-1913, 45 YEARS

No.	Exceedance Interval	5 Min.	10 Min.	15 Min.	20 Min.	30 Min.	40 Min.	50 Min.	60 Min.	80 Min.	100 Min.	120 Min.
1....	45	9.00	8.22	8.00	6.93	5.22	4.38	3.84	3.40	2.70	1.88	1.33
2....	22.5	8.04	7.20	6.40	6.00	5.12	3.93	3.32	3.02	2.20	1.44	1.31
3....	15	7.80	6.12	5.00	4.35	4.08	3.69	3.17	2.68	1.65	1.36	1.21
4....	11.25	7.44	6.00	4.88	4.20	3.30	2.70	2.88	2.66	1.62	1.29	1.10
5....	9	6.96	5.70	4.68	4.05	3.16	2.60	2.14	1.90	1.47	1.23	1.07
6....	7.5	6.48	5.16	4.60	3.93	3.00	2.49	2.04	1.85	1.46	1.20	1.07
7....	6.43	6.36	5.16	4.56	3.81	2.98	2.40	2.04	1.74	1.44	1.20	1.05
8....	5.62	6.00	4.98	4.52	3.78	2.90	2.18	2.00	1.72	1.39	1.20	1.01
9....	5	6.00	4.74	4.20	3.45	2.30	2.10	1.99	1.68	1.37	1.13	.96
10....	4.5	6.00	4.68	4.12	3.21	2.30	2.07	1.90	1.60	1.36	1.11	.96
3	Mean....15	7.85	6.65	5.79	5.11	4.18	3.46	3.07	2.73	1.93	1.44	1.20
8	Mean.... 5.62	6.17	4.94	4.40	3.64	2.70	2.25	1.99	1.72	1.40	1.17	1.01
13	Mean.... 3.08	5.98	4.44	3.46	2.97	2.22	1.86	1.67	1.51	1.25	1.00	.82
18	Mean.... 2.27	5.38	3.80	3.10	2.54	2.09	1.68	1.47	1.32	1.02	.82	
23	Mean.... 1.96	4.94	3.56	2.91	2.40	1.90	1.59	1.36	1.18	.94		
28	Mean.... 1.61	4.78	3.34	2.76	2.32	1.80	1.47	1.25	1.12	.88		
33	Mean.... 1.36	4.44	3.19	2.66	2.23	1.73	1.40	1.21	1.07			
38	Mean.... 1.18	4.22	3.07	2.60	2.11	1.65	1.37	1.16	1.01			
43	Mean.... 1.04	4.18	3.00	2.56	2.02	1.59	1.32	1.12	.96			
48	Mean.... .94	3.88	2.94	2.46	1.97	1.54	1.26	1.07				
53	Mean.... .85	3.60	2.83	2.37	1.94	1.48	1.18	.98				
58	Mean.... .78	3.60	2.70	2.29	1.85	1.41	1.11					
63	Mean.... .71	3.43	2.66	2.18	1.76	1.36	1.05					
68	Mean.... .66	3.36	2.60	2.07	1.72	1.34	1.00					
73	Mean.... .616	3.24	2.53	2.01	1.63	1.26	.96					
78	Mean.... .58	3.24	2.48	2.00	1.57	1.20						
83	Mean.... .542	3.09	2.40	1.98	1.51	1.13						
88	Mean.... .511	3.00	2.40	1.94	1.50	1.06						
93	Mean.... .484	3.00	2.30	1.90	1.50	1.02						
98	Mean.... .459	3.00	2.28	1.78	1.48	1.00						
103	Mean.... .437	3.00	2.20	1.66								
108	Mean.... .417	3.00	2.11									

given time duration form a basis of a frequency curve of rain intensities of the given duration. The data are plotted on the diagram, Fig. 15, on which triangles have been used to designate the ten highest actual values, and circles to designate the means of the groups of fives for each duration. The resulting curves somewhat resemble parabolic arcs, and can be represented approximately over a considerable range by straight lines on logarithmic paper.

As a result of extended study of frequency phenomena in relation to rainfall, floods and other hydrologic data, the writer has become convinced that such frequency curves are not truly parabolic and that the application of parabolic formulas or other similar expressions which indicate the possibility of infinite rain or flood intensities of any given duration if only the time limit is made long enough, are incorrect, and may lead to gross misconception, if applied beyond the limit of the data from which they are derived.

The writer has found that frequency curves of rain intensities and flood intensities can, in general, be represented with considerable accuracy, by at least two, or perhaps more empirical equations having such forms as to indicate a finite maximum or limit which the rain intensity or flood magnitude approaches, as the exceedance interval approaches infinity as a limit.

Without going into details as to the method of developing the formula or deriving the constants, the expression used to represent the frequency curves of rain intensities shown on Fig. 15 is

$$i = a\,(1 - e^{-kT^n})$$

in which e is the base of Napierian logarithms, T is the exceedance interval in years, and a, k and n are constants for a given duration of rainfall. The constants a, k and n are different for each curve, that is to say, for each rainfall duration. They are functions of the rainfall duration in minutes, and are related to the rainfall duration in the manner indicated on Fig. 16. The values of the constant a indicate the maximum value which the rain intensity of any given duration approaches as a limit as the exceedance interval is indefinitely increased. For illustration, the limiting rain intensity which may be expected at New York City, as shown by the diagram, for different durations, is as follows:

5 minutes, 13.9 ins.
10 minutes, 13.0 ins.
15 minutes, 12.2 ins.
20 minutes, 11.4 ins.
30 minutes, 9.8 ins.
40 minutes, 8.4 ins.
50 minutes, 6.8 ins.
60 minutes, 5.75 ins.
80 minutes, 3.60 ins.
100 minutes, 2.2 ins.
120 minutes, 1.5 ins.

The frequency-intensity curves for different durations computed from the general formula above given are shown by the curved lines on the diagram, Fig. 15.

The formula above given is in the form of a frequency equation. It can, however, readily be thrown into the form of a rain intensity equation for any chosen frequency, that being the form of expression most commonly used in storm sewer work. The formula appears complex, but when one becomes accustomed to working with exponentials, the solution of such an equation is as simple as that of an ordinary parabolic equation with a fractional exponent and which is usually solved by logarithms. For practical purposes a diagram is to be preferred to the direct solution of rain intensity equations

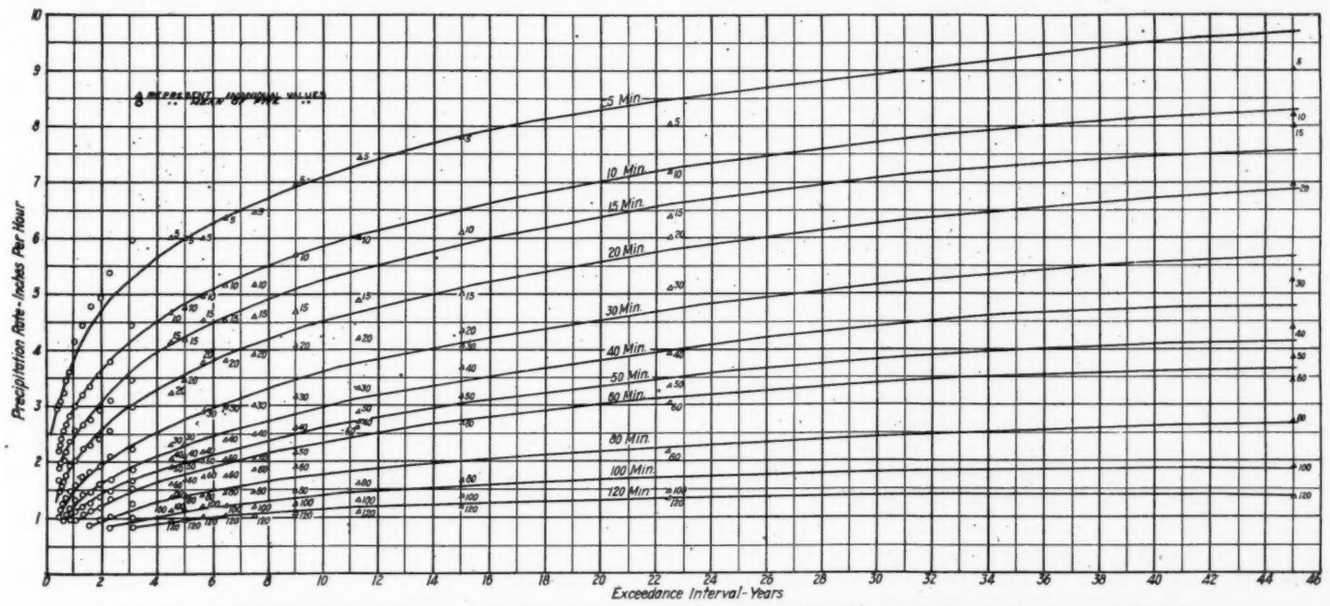


FIG. 15. FREQUENCY CURVES OF EXCESSIVE RAINFALLS AT NEW YORK CITY, 1869-1913 INCLUSIVE.

in most cases. The principal advantage claimed for the form of equation here given is that it enables one to determine the apparent limiting values approached by rain intensities of different durations. These limiting values are not obtainable directly from the data, or from the curves derived therefrom by any method of plotting, without deducing the frequency equations.

It may be noted that the constants in rain intensity equations derived by this method are determined by selecting from the curve for a given duration three pairs of values of the variables. Two of these pairs of values may be taken from the left-hand portion of the diagram, where the locations of the curves are fairly well defined by numerous plotted points. It follows that by this method of analysis and use of rain intensity data weight is given in a large measure to the more numerous and better established points on the diagram corresponding to intensities of relatively frequent occurrence, as well as to the higher observed and less frequent intensities.

Conclusions

(1) Excessive rain intensities for short time intervals mostly occur in thunderstorms, or in storms of the thunderstorm type.

(2) Rainstorms producing maximum intensities are mostly the result of violent uprushes of warm moisture-laden air as the result of convectional overturning of overheated air near the ground surface. Such conditions are indicated by the occurrence of cumulus "thunderhead" clouds, thunderstorms, and hail storms.

(3) These conditions may occur on warm, still, clear days, often known as "weather breeders"; thunderstorms, however, most commonly occur in favorable places along the course of, and during the passage of a general cyclonic storm, and in their most violent form during the passage of a barometric "trough," or "squeeze" with a marked "wind shift line."

(4) The occurrence of thunderstorms and high rain intensities are conditioned by (a) high temperature, (b) moist air, and (c) other favorable atmospheric conditions, probably at the cloud level and not fully understood.

(5) As a result thunderstorms and excessive rain intensities vary in frequency and magnitude as a rule under the same conditions that produce variations in rainfall. They are most common in tropical latitudes, and decrease toward the poles owing to decreased temperature, and their occurrence is mainly limited to the summer months. They usually decrease proceeding inland from the coast as the moisture content of the air decreases.

(6) Excessive rain intensities and the occurrence of thunder and lightning are the results of a common cause—violent ascentional air currents. They commonly occur in conjunction, but either may occur without the other.

(7) The occurrence of thunder affords, however, quite positive proof of the existence of suspension storage and the sudden precipitation of such storage is probably a usual cause of the highest rain intensities for very short intervals up to say 5 or 10, or perhaps 20 minutes.

(8) The highest rain intensities for somewhat longer intervals, say 15 to 45 minutes or 1 hour, seem mainly to be controlled by the occurrence of storm gusts or pulses.

(9) Excessive rain intensities for still longer intervals as 1 hour to one or more days are the result of general cyclonic storm conditions. Here the effects of suspension storage and of individual gusts become relatively unimportant.

(10) Under these conditions it is obviously difficult to devise any one simple type of rain intensity formula that will actually represent average rain intensity and duration relations over any large range of time intervals. It appears, however, that the relation of rain intensities to duration under each of these three conditions partakes in a considerable degree of an exhaustion phenomenon, so that all these types of intensities may follow similar laws, but with different coefficients and limitations—furthermore, two or even all three of the above described conditions precedent for rain intensities may operate in the same storm, so that it is possible to represent rain intensity—time relations over considerable time intervals by a single empirical formula.

(11) The amount of suspension storage which can be sustained by an ascending air current, and the rate at which it can be precipitated, are limited by natural physical conditions. In fact the velocity of ascending convectional currents seems to be practically limited by the relation between buoyancy and rate of ascension, as a result of the tendency of a mass of air to ascend when the point of instability is reached, thus naturally restricting the building up of air masses capable of ascension at more than a certain critical rate. It follows that there seems to be a fairly definite and fixed maximum limit

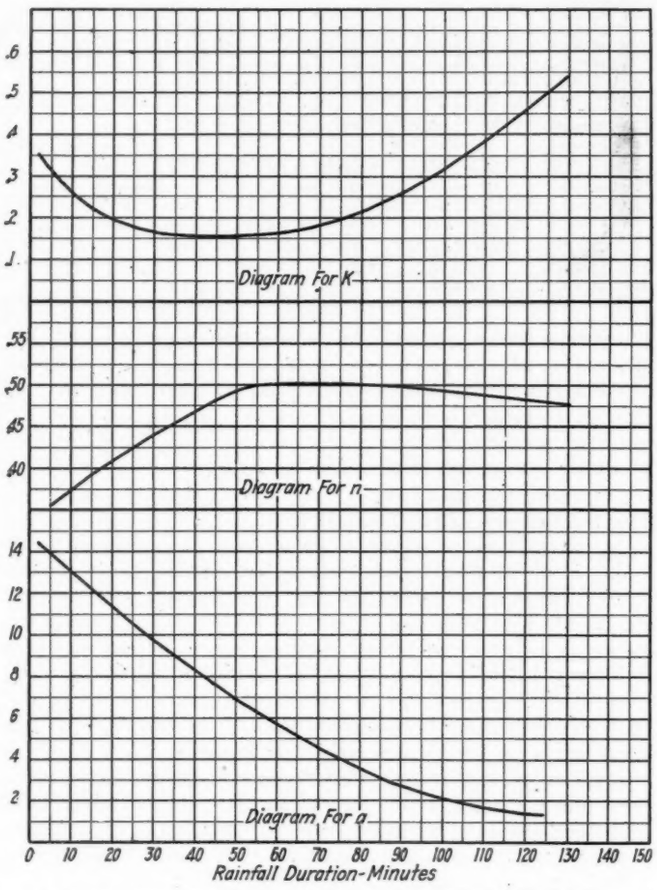


FIG. 16. CONSTANTS IN RAIN INTENSITY-FREQUENCY FORMULAS FOR NEW YORK CITY, 1869-1913.

of rain intensity for short time intervals, as say 5 minutes, which is not likely ever to be greatly exceeded. This limit seems to correspond to an intensity of 10 or 12 ins. per hour for a 5 minute interval, throughout most of the eastern United States.

(12) It is notable that this limit of maximum rain intensity due to storage suspension does not appear to vary greatly in amount, even between places having quite widely different annual rainfall and thunderstorm frequency. The important difference in the characteristics of rain intensity at different stations in Eastern United States seems to be mainly one of frequency rather than of magnitude. For example, the limiting or maximum rain intensity for 5 minutes to be expected in two locations may be about the same, but the frequency with which an intensity approaching this limit will occur in two places may be widely different—the frequency of occurrence of intensities approaching the limiting value being as a rule greatest in regions of numerous thunderstorms and high annual or seasonal precipitation.

(13) While the reasons are not so apparent as in the case of suspension storage, there is some statistical evidence, derived from the study of equi-frequent rain intensities of long durations, at various places, that tends to show that there are maximum limits of rain intensity for long as well as for short durations—in other words, it appears that there are certain intensities for say, one-half hour, one hour, or two hour durations which for practical purposes may be considered as never exceeded in a given locality—furthermore, these limiting intensities may be quite similar in different localities, although the frequency of lower intensities may be greater in regions of heavy rain and high thunderstorm frequency than elsewhere.

(14) It is possible by proper statistical methods to determine the limiting values of rain intensities of different durations from an analysis of observed intensities and frequencies, and such a determination appears to furnish results of more definite value than are to be obtained by the usual methods of use of rain intensity records heretofore applied. The conception of a maximum intensity of a given duration which is approached as a limit as the exceedance interval increases has an important bearing on the application of rain intensity to storm sewer design.

(a) It represents the maximum rain intensity of a given duration for which it may be necessary to provide sewer capacity in extreme cases.

(b) It may not be necessary to provide for the limiting rain intensity in all cases, owing to economic conditions. If the maximum or limiting intensity is not provided for, then its value indicates the extent to which the sewer capacity may be exceeded at rare intervals.

(c) The limiting intensity for a given duration represents a value beyond which it is never necessary or advisable to go in providing storm sewer capacity.

(15) Unit rain intensity may be defined as the intensity for a given duration having a given exceedance interval, as for example the 5-minute intensity of one year exceedance interval. The use of unit intensity furnishes a proper basis of comparison of rain intensity conditions in different places. If unit rain intensities for different places are compared respectively with thunderstorm frequency, total precipitation during the summer or thunderstorm months, and with annual or total precipitation at the same places, it will be found that there is usually a fair degree of correlation between unit rain intensity and thunderstorm frequency, unit rain intensity and summer precipitation, and summer precipitation and thunderstorm frequency, respectively. The correlation between unit rain intensity and annual precipitation is appreciable, but materially less than the others mentioned, for the reason that annual precipitation reflects the effect of thunderstorm rains to a much smaller degree than does the precipitation during the summer or thunderstorm months.

(16) At a given station the greatest single storms, the greatest daily maximum rainfalls and the greatest intensities for short intervals usually occur in years having the highest total annual precipitation.

(17) The writer has not attempted in this article to give definitive formulas of general applicability for the expression of the relation between rain intensity, duration and frequency. It is hoped that the results given will suggest and encourage further study along similar lines, such as may afford a more complete basis for generalization. The requirements for a rain intensity formula based on investigations thus far made may be stated as follows:

(1) It should indicate a finite intensity for zero duration and for the minimum exceedance frequency.

(2) For a given duration, the rain intensity should approach a finite maximum or limiting value as the exceedance interval increases.

(3) This maximum or limiting value should decrease as the duration interval of the rain increases.

(4) A single general type of formula should be applicable over extensive geographic areas and to regions varying in amount of seasonal precipitation and thunderstorm frequency.

(5) The formula may contain constants whose values in turn can be expressed either in terms of unit rain intensity, thunderstorm frequency, or total precipitation during the thunderstorm season.

(6) The form of expression should be such as to give the required intensity in terms of duration and exceedance interval, so that when the constants are known for a given location, intensities of varying duration but of the same frequency can be determined directly on the one hand, or intensities of the same duration but of varying exceedance intervals can be obtained directly on the other hand.

A Review of Recent Progress in Brick Pavement Design and Construction

By Clark R. Mandigo, Consulting Engineer, Western Paving Brick Manufacturers Association, Dwight Bldg., Kansas City, Mo.

Engineers who have been interested in pavement construction and design for the past 15 years are familiar with the truly remarkable improvements made in all classes of pavements during that time. This progress, while rapid, has been taken usually step by step and is not realized except in retrospect covering a number of years. Necessity, of course, has been the mother of invention in this case; the enormous increase in the amount and character of traffic as well as in the amount of paving have kept municipal engineers on the jump. Progress has relegated to the by-ways certain types of pavements which were extensively used 15 years ago, but it has failed to bring forth any out-and-out new type which has proved of any particular worth. The substantial development, as was prophesied by eminent engineers, has been entirely in the improvements of types of pavement existing at that time.

Great Progress Made With Brick Pavement

In no case has greater progress been shown than in one of the oldest types of pavements—brick. Because improvements in brick pavements have been continuous, gradual and prosaic rather than spectacular, the truth of the above statement is not generally realized. Then, again, the modern brick pavement is still called brick pavement and to the average man that means the particular brick pavement he sees the most frequently regardless of when it was built rather than the latest type of that pavement. Brick pavements have, of course, advanced with other types of pavement as a result of the accumulation of engineering knowledge in regard to materials and methods of construction, but great progress has also been made in the manufacture of the brick themselves and in the details of construction which can be credited to this type of pavement only.

Improvements in Brick Making

At the manufacturing end, modern machinery, expert technical advice, and specialization have much increased the quality and uniformity of the product. It used to be thought that any one could start a brick plant near any convenient bed of shale and with temporary buildings, inexpensive equipment and common labor turn out a brick suitable for either building or pavements. Nowadays there are many industrial plants representing large investments of capital in permanent construction, and the latest machinery, employing high priced labor and management, which specialize in paving brick. Since the manufacture of paving brick does not depend on any secret or patented process and the raw materials are found in many sections of the country, the sale of the finished prod-

uct depends entirely on furnishing the best material at the lowest price. The positive rattler test which is standard throughout the United States, enables engineers to select the material with assurance as to its quality without regard to its place of manufacure. These factors have tended to a gradual improvement in the quality of paving brick on the market, the elimination of the unfit, and have made possible the development of the niceties in design and manufacture which make brick desirable for all classes of streets and roads. Only a few of the most important improvements need be mentioned.

The Vertical Fiber Brick

As the result of experiments made by C. Fuller, a ceramic engineer, at the Buffalo Paving Brick Plant in Kansas, a number of plants placed the so-called Vertical Fiber Paving Brick on the market in 1912. This type of brick has been so successful that the entire product of the Western manufacturers at present is vertical fiber brick and it was adopted last year as the standard paver of the National Manufacturers Association. Briefly these experiments showed that the tempered shale was built up in the forward part of the augur machine in a series of spiral layers, and that in being pushed through the "former" and die these layers became long superimposed cones the axes of which were the center line of the clay column. The particles of shale themselves have a tendency to arrange themselves with their longest axes in the same direction. The vertical fiber brick are designed to be laid so that these axes are perpendicular to the pavement wearing surface, while the older types of paving brick are laid with these axes parallel to the surface. In an imperfect or weak brick this difference is quite noticeable, but is of minor importance in perfectly vitrified brick. The vertical fiber brick is not repressed and the spacing of the wires on the cutter determine the depth of the wearing surface. The die remains the same for all depths of brick and where lugs are required they are formed as bars by grooves in the die. This explanation may clear up some confusion that seems to exist among engineers who are not familiar with this type of paver. There are, however, many other advantages to this method of manufacture.

VIEW OF 4-INCH VITRIFIED VERTICAL FIBER BRICK BLOCK PAVING, WITH SQUEEGEED ASPHALT FILLER, ON SOUTH MAIN STREET, JOPLIN, MO.

Sizes of Brick

The brick is non-repressed which makes it stronger and freer from structural defects such as laminations. It may be made any depth desired and therefore a depth wearing surface obtained to fit economically the class of traffic it will support. Commercially they are made in 2½, 3 and 4 in. depths, of which the 3-in. depth is used in the majority of cases due to the economies of manufacture in handling. The 3 in. depth brick has proved amply strong for the heaviest loads and densest traffic and are economical for roads and residence streets though many 2½ in. brick are used for these lighter traffic streets. The 4 in. brick is now used in the middle west in only a few of the largest cities. The brick are all 4 ins. wide and 8½ ins. long. In other types of paving brick, it is very difficult to make a brick less than 3½ ins. in depth, since the depth of the brick is determined by the height of the die and a long narrow die gives a clay column of unequal density and torn corners.

In the vertical fiber, the reticulated wire cut surfaces are a plane and one of these is uppermost in the pavement making a gritty surface which affords a good foothold for horses and a good grip for auto tires. The brick are as large as can be conveniently handled thus reducing the number of joints. Only 35 are required to lay one square yard of pavement. All four edges exposed to traffic are square, making a uniform width of joint from top to bottom on all sides. They are piled on edge in the kiln and therefore all warps, kiln marks, etc. come in the joints on the pavement and not on the wearing surface, making a much smoother, more even surface. On account of the greater proportion of square edges per unit of weight, the allowable abrasive loss in the standard rattler is usually fixed at 24% for a 3 in. depth brick. It has been found that this limit gives a better quality of brick material than 21% test on the old standard repressed block. The vertical fiber brick is especially adapted to bituminous fillers in which case a lugless block is usually specified. As the process of manufacture is not patented in any respect, practically every paving brick plant is now manufacturing the vertical fiber brick and it composes the entire output of the plants in the middle west.

Improvements in Construction Methods

In recent years many improvements have been made in the methods of constructing brick pavements. In no feature of the design of pavements are engineers further apart at present than in the foundations necessary to carry the loads. Experiments are now under way which will give valuable information regarding this phase of the subject. It is well to remember in this connection that the function of the foundation is the absorption of impact and the distribution of the loads over the subgrade. A more thorough knowledge of soil conditions and treatment about which so much has been said and so little known is of great importance. There is much to be criticized in the present methods of design, especially on country roads. Too much emphasis is apparently being laid on the beam bearing strength of the foundation and not enough attention paid to the distribution of the loads coming near the edge of the pavement, for example: Due to the shock absorbing and load distributing qualities of the sand cushion and brick wearing surface it is usually assumed that brick requires 15 to 20% less thickness of foundation than a soft wearing surface and it is probable that future experiments will point the way of taking still further advantage of these characteristics. The development of the monolithic

brick pavement is comparatively recent and has much to commend it in its economy in load carrying capacity. It is especially adapted to country roads, but is of course a rigid slab type of surfacing and subject to some of the inherent defects of that type.

The substitution of the cement-sand cushion and the reduction in its thickness has removed the risk of the thick plain sand cushion where cement grout is used as a filler for the brick. Where bituminous filler is used a thin plain sand cushion is used, since the elastic joints give each brick an opportunity to remain properly bedded in the cushion.

Bituminus Fillers

Within the last ten years, bituminous fillers have again come into use and in the middle western states for example, are now used almost exclusively in brick pavements. The changed character of traffic and the use of asphalt instead of pitch, has eliminated any objections which formerly held against this type of joint filler. An asphalt can be obtained at a reasonable cost, which is pure, has a high melt point, is little affected by changes of temperature, is adhesive, elastic in cold weather, and long lived. Only the best quality asphalt should be used. Formerly bituminous fillers were poured from cone cans, the specifications requiring that none should "be spilled on the surface of the brick." In spite of every precaution joints poured individually in this manner settled in warm weather. The accepted method of applying asphalt filler today, is to flush the hot filler over the surface from cans or buckets and move it back and forth with squeegees until the joints are full. A coating of sand absorbs the surplus remaining on the surface. This surface coating acts as a mastic reservoir for keeping the joints full as they settle in warm weather so that by the time it has worn off, the joints are completely and solidly filled. This surface coating is therefore simply an incident to the proper filling of the joints and is not intended as a carpet or wearing coat.

Advantages of Asphalt Filler

In addition to its waterproofing qualities, the asphalt filler is easily and simply applied and there is no expense of protecting or curing it with the attendant possibility of damage by rain, frost, heat or premature traffic. The pavement is ready for traffic as soon as the filler is applied. Plumber's cuts or other openings in the pavement are easily repaired. The chief advantages, however, of an asphalt filled brick pavement are: (1) it provides a resilient, easy riding surface which is not slippery under any ordinary conditions of weather, grade or class of traffic; (2) it eliminates noise; (3) all expansion or contraction troubles are done away with; (4) it absorbs shock and impact, and (5) it makes a semi-flexible wearing surface which allows for slight readjustments between the individual brick or readjustment of a portion of the surface to conform to changes in the condition of the sub-grade, the foundation, or the sand cushion.

It was expected at first, that brick pavements with asphalt filler would require some maintenance of the joints. Pavements 8 to 10 years old under various classes of city traffic, however, look better than when just laid and the joints as a rule remain full. In fact this type of brick pavement has shown even less expense for maintenance than cement grouted brick, since there are no cracks formed and no bricks chipped or sheared from expansion strains.

Integral Curb on Country Highways

On country highways, the bituminous filled brick pavement requires some sort of an edging. This is usually provided by a flush concrete curbing 6 to 12 ins. wide, built at the same time and integral with the concrete base. By using the same mixture as is used in the concrete foundation, this edging can be built cheaply. Half inch joints in the curbing are usually provided at intervals extending down to the top of the foundation to provide for surface expansion and drainage of the sand cushion.

It is not intended in this article to discuss all developments in brick pavement design and construction as many of them are familiar to every engineer, but to mention some of the details of constrution of a type of brick pavement the use of which has been more or less sectional for a number of years, due no doubt to the fact that very little has been written about it in the technical press.

There is no question that a well manufactured brick of as large a surface area as can be conveniently handled, a depth proportional to the amount and character of traffic and true in shape and size, laid on a sand cushion of an inch or less in thickness, on a suitable foundation, joints as narrow as possible, and filled with a good grade of asphaltic cement, and laid so that the joints are at an angle to the direction of traffic, makes a brick pavement as different in appearance and in service from brick pavements laid 15 years ago as the 1919 model automobile is different from the auto of that time.

FORMS SET FOR INTEGRAL CURB FOR A KANSAS BRICK ROAD WITH ASPHALT FILLER.

Shows Method of Suspending Front Form, a 2x4 to Curb by Spacers and Clamps from Rear Form.

Road-making Plans of Indiana for Near Future

To the Editor:

In regard to the road-making plans of Indiana in the near future, I would say that at the present time we have a considerable force of engineers employed in the preparation of plans and specifications for the 1919-1920 work. It is expected that there will be available for the work during these two seasons approximately $17,000,000 including both the State funds and funds furnished by the Federal government under the Federal-aid act.

We have been busy since the 6th of May organizing the State Highway Department and preparing standard specifications for the approval of the United States Bureau of Public Roads, together with detailed plans for several projects which it is proposed to construct in 1919-1920.

We will advertise soon for bids on approximately 46 miles

of improved roadway. Alternate bids are asked for concrete, monolithic brick and bituminous concrete. Other lettings will follow as soon as the plans are completed until approximately 100 miles are let. This mileage will cover the available funds that the Commission will have for work during the seasons of 1919-1920.

The work this year, therefore, will be making the surveys, preparation of plans for roads and projects to cover the work for 1920 which will be a large portion of the work carried on by the Commission in the next two years. In addition to organizing and equipping survey parties and designing department for road work, we have organized and equipped a bridge department to take care of 20 ft. span of which there are quite a number on the state highways to be constructed. The Indiana Law requires that bridges of over 20 ft. span be let separately. Also that plans be prepared for both steel and concrete bridges and ultimate bids asked for on each. This involves double engineering.

The Commission and the Director are busy complying with the provisions of the law which requires that the Indiana State Highway Commission shall designate a system for the entire state before April 20, 1920. We are now engaged in making field inspections to locate the system properly to include county seats and all cities of over five thousand population.

Very truly yours,

H. K. BISHOP, Chief Engineer,
Indiana State Highway Commission.

Indianapolis, Ind., June 23, 1919.

Compensation for Municipal Engineers

To the Editor:

The subject of compensation for civil engineers is worthy of discussion and if there is any way to improve conditions, it certainly would be appreciated by the profession: even today, the wage of the engineer, in many cases, is far below that of the most ordinary mechanic and but little above that of common labor.

The engineering profession does not rank today with other professions; this condition was not so pronounced, back in the "80's," yet the greatest change has taken place since 1914, or the beginning of the world war, causing a shortage of common labor, a slackening of public work and the sudden rise in all commodities, leaving the engineer, with an open profession, to fight for an existence.

Almost all professional men, having a closed profession, have advanced their charges for service, in proportion to the increased prices of commodities. Trade unions have advanced their wages in accordance with their ability to raise, so the engineer, with an open profession, must plod along through all financial depressions and political storms without a murmur.

The laws of our state, fix the salaries of the city engineers; these salaries were fixed in the year 1905. The salaries range from the meager sum of $1,000 to $3,500 per year, according to the class of city, and but little change has taken place since then, except possibly an occasional engineer landing in the poor house.

Consider the cost of living at the present time, the increase in wages to skilled and common labor since 1905, and then observe the difference between "law and justice," as far as the engineer is concerned.

Now as to the municipal engineer entering politics in order to better his condition, I question the practicability of this course. Having been employed by our city, "with the exception of one year," since 1902 as city engineer, also serving as a member of the Board of Public Works in conjunction with the office of city engineer for several years, I find that politics and efficiency do not work well together. I am heartily in favor of classifying the profession, and for any fair method of increasing its compensation.

Very truly yours,

T. E. PETRIE, City Engineer.

Marion, Ind., July 2, 1919.

Recommendations Pertaining to Street Openings and Pavement Restoration

A committee report on "Pavement Restoration and Street Openings" was made and approved at the recent annual meeting of the National Highway Traffic Association. Messrs. B. H. Wait, W. T. Chollar and J. B. Vandever composed the committee and their report was substantially as follows:

Unfortunately, a very large percentage of street openings occur in the large cities where traffic is heavy and such openings cause a maximum of inconvenience. The committee investigated the subject from the following angles:

First—Reducing the number of street openings to a minimum. Second—The issuance of the permit and the placing of responsibility for the work. Third—Proper execution of the work and the care of traffic while such work is under way. Fourth—The restoration of the pavement.

In order to gather information on present methods, a questionaire was sent out to all of the largest cities in the United States and about 65 replies were received. These showed lack of uniformity in methods as well as ordinances relating to the work.

After studying these over the committee did not attempt to recommend uniform ordinances, specifications, or methods. They did, however, recommend the following procedure:

Recommended Procedure

FIRST—In order to minimize the number of openings:

(a) Keep detailed records of all sub-surface structures laid in order to do away with openings made to locate such structures.

(b) Rigid inspection by the city of the construction of all sub-surface structures, whether privately or publicly owned, in order to insure the best construction and to lessen the number of openings to repair leaky joints, etc.

(c) Approval by the city department in authority of all plans of sub-surface structures in order that they may be laid where there will be a minimum amount of disturbance of the pavement for present and future work.

(d) Separate systems to be laid under sidewalk areas where practical. If this cannot be done that all surface connections to all property be required previous to placing of the pavement.

SECOND—Issuance of the permit and placing responsibility for the work.

(a) Permits to be granted by the city department in authority to licensed plumbers, contractors, and public service corporations only after the submission and approval of detailed plans of the work to be undertaken.

(b) Cash deposit to be made to cover the estimated cost of the work to be done by city forces and,

(c) Bond to be required to indemnify the city against legal action due to accidents or other causes.

THIRD—Wherever it is practicable it is recommended that the city complete all work subsequent to the excavation and laying of the mains or conduits, including back filling, temporary pavement where necessary, and permanent pavement.

Where this is impracticable, that the back filling be done under city inspection by the person, firm or corporation to whom the permit is issued.

FOURTH—Restoration of pavement.

No restoration of permanent pavement should be done by the contractor but all of this work should be done by city force to be paid for from the cash deposited previous to starting the work by the person, firm or corporation to whom the permit was issued. If impracticable for the city to follow back filling closely with permanent pavement, suitable temporary pavement should be placed by those doing the work and permanent pavement be placed by the city force as soon as practical after completion of the back filling.

In the opinion of the Committee it is very important that the city's portion of every activity in connection with plans, permits, construction, etc., should be handled by the Highway Department or similar department of the city. This will result in less "red tape" and consequently—less delays.

It is the opinion of the Committee that in the majority of cases, if the work is properly done, that permanent foundation can be placed immediately following the completion of the back filling. In such cases, the depth of the foundation should be made from 4 to 6 ins. deeper than the ordinary depth of the pavement foundation on the street.

The width of cut in the foundation should be from 1 to 2 ft. wider than the width of the trench, depending on soil conditions and the top of the trench excavation should be beveled back so that the new foundation will have a bearing against the side of the trench.

The committee is of the opinion that whenever practical it should be required that all cuts be made of standard widths and that precast slabs of the standard widths and sizes be made up and stored ready for placing and grouting as soon as the back filling is completed. In small openings this will allow the city force to place both foundation and pavement surface in one operation, resulting in earlier completion of the work and less inconvenience to traffic.

Some Features of Hydro-Electric Engineering Practice and Possibilities

By H. de B. Parsons, Consulting Engineer, 22 William St., New York City

Generation of power is accomplished by use of water, coal, gas and oil. Of these natural resources, water probably offers the most attractive features, as it has capacity for operating very large generating stations, picturesqueness in its surroundings, and requires interesting preliminary study. Furthermore, suitable control and regulation of flowing water will relieve "power shortage" which was shown to exist by the recent war.

The growth of science, through experimental and research work, and its application to the uses of mankind during the past 75 years has been bewildering. Judging the future by the past, bold indeed would be the man who would care to predict or deny what the next century may show.

The commercial employment of electricity was not accomplished until the last third of the nineteenth century. Suddenly, as if by magic, electrical improvements and developments followed one upon another, and electric energy became a source of light, heat, power and traction. Both high tension and alternating currents came into use as a natural sequence of increased knowledge, and at once it became feasible to transmit the mysterious "electric fluid" over long distances at commercial rates. Hydro-electric plants were developed for the purpose of generating and transmitting current across country to distant points. The present commercial endeavor is electrically to connect generating stations on the same and on different watersheds, and to operate all as a single system under one control. This unity of operation has the advantages of reducing drop in voltage due to line resistance, saving in overhead charges, and enabling the peak loads of some plants to be carried by others.

One Development Serves 84 Cities and Towns

The developing and electrically connecting of different watersheds has progressed to a marked degree in some western states, and the aggregate of water power under one control, both developed and owned or controlled for future development, is large. One such company has about 340,000 kilowatts (454,000 h. p.) capacity, of which 212,500 kilowatts (283,300 h. p.) has been developed and is being operated over about 1,900 miles of transmission lines, furnishing light and power to some 84 cities and towns. Under proper management this unity of operation will show economies over any plan of separate operation.

During the recent war in Europe, the public demand for fuel conservation encouraged a similar plan in the eastern states, and the growth of such interconnection of power plants will increase as time advances. There is a steady increasing demand for light, traction and industrial power. Many new enterprises will require current for recovery of nitrogen from air, for electro-chemical processes, and for utilization of waste products. In consequence, some water powers, previously of little commercial value, have become financially inviting projects because the electric current generated can be transmitted for 200 miles or more and sold at profitable rates.

Cost of Water Power Development

The cost of developing a water power is high, and ordinarily varies from two to five times that of a steam plant of equal capacity. A large proportion of the first cost is for construction of dam, head race, tail race, riparian rights to secure lands that will be flooded, rights of way for and construction of transmission lines. Consequently, interest forms a heavy annual fixed charge per horsepower. Interest is especially heavy if only a portion of the possible power-generating apparatus be installed. Dams and pondage should be constructed for full development, although the first demand might be only for part power. Water wheels, generators, and transmission lines can be added as required, but dams, races, and pondage are most difficult to enlarge after first construction.

Potential Water Power

The potential power of falling water depends on temperature, altitude and latitude. Loss of weight due to temperature and diminished force of gravity from high altitudes and low latitudes, are small and can be neglected in estimating power available. Although the kilowatt is the same everywhere, the foot-pound varies, since the local weight of a "pound" changes at different places, due to altitude and latitude. Consequently, the kilowatt is a better unit of measurement than horsepower. A horsepower is taken at 0.746 kilowatts, equivalent to 550 ft. lbs. However, on the equator at sea level the equivalent would be 551.70 ft. lbs., and on latitude 60 degress at 5,000 feet elevation 549.52 ft. lbs.

To determine approximately the amount of electrical power that can be delivered at the end of a transmission line, the following formula will be found useful for preliminary work:

$$\text{Kw. delivered} = 0.055\ H.\ Q.$$

in which H denotes head of water fall in feet
Q denotes water discharged in cu. ft. per second

Transmission Lines

A transmission line costs, complete, including right-of-way, about $2,000 to $2,500 per mile, and at the present time the average cost is about the same for wooden poles and for steel structures. Lumber is getting scarce, and as suitable wooden poles are difficult to obtain, the increasing cost soon will prohibit entirely their employment. Steel has many advantages

over wooden poles, such as flexibility—since it does not break by snapping—ability to withstand strains, smaller number per mile, and longer life.

The loss in transmitting electric power (volts times amperes) varies as the square of the current. In consequence, the higher the voltage the less will be the loss in power when transmitting the same amount of energy. For long transmissions the voltage is always high, and varies in common use from 30,000 to 125,000 volts. Alternating current is employed because it can be transformed economically by "stepping up" from generator voltage transmission, and again "stepped down" from transmission at the point where the power is used.

Weight of Copper

The cost of copper wire is a large item of transmission cost. The size of copper wire is determined by the "drop" or loss in voltage allowed. The weight of copper in pounds per kilowatt delivered at 10 per cent. energy loss in line, can be closely estimated at

$$28 \left(\frac{\text{Distance in miles}}{\text{Volts in thousands}}\right)^2$$

For any other loss in per cent., correct above result by multiplying by $\frac{10}{\text{Assumed loss in per cent.}}$

Disadvantages of Water Power

Hydro-electric power is subject to annoying variation, to which steam power is not. Causes which reduce the value of water power in comparison with steam power, are floods, which frequently raise the tail water so as to reduce the effective head; variations in stream flow; droughts; ice; breaks in transmission lines caused by wind, sleet, and lightning; and line loss of voltage due to load (the higher the load the greater the loss). Many of these items can be offset in part by an auxiliary steam plant, but the interest on such a plant adds to the fixed charges.

Advantages of Water Power

The development of a water power, like any other business enterprise, must compete in the market for capital. Unless the enterprise is attractive in its returns, capital will not be readily obtainable. As a water-power plant has many attractive features, when compared with steam, the difficulty of obtaining capital is largely offset. Operating costs are capable of being estimated accurately, as the cost of water is largely interest plus taxes plus depreciation, while for steam the price of coal and cost of delivery are continually rising and can only be approximated for future years. When examined and reported on by competent engineers, capital will be much reassured. All things being considered, the features of good water-power developments always will be attractive, and the attraction will grow rather than diminish.

Available Water Power Five Times Greater Than Developed Steam Power

In the United States the developed water powers are capable of generating probably 6,000,000 h. p. while the water powers not as yet developed, but capable of development, could generate perhaps 50,000,000 h. p. without storage and 200,000,000 h. p. with storage.

It has been estimated that the aggregate power generated in steam plants in the United States is between 26,000,000 and 40,000,000 h. p. In addition, there are about 60,000 steam locomotives, with a maximum capactiy of about 36,000,000 h. p., of which about 4,000,000 h. p. may be in actual daily service. These two classes would give about 40,000,000 h. p. as the total for steam. In other words, developed water powers amount to only about one-seventh of the steam powers, although the available power is nearly five times that of steam now in use. The potential water powers are not evenly distributed throughout the various states, but are in greater magnitude where coal is lacking. The distribution has been estimated in percentage of total potential water power in the United States, as below:

New England States—Maine, Vermont, Massachusetts, New Hampshire, Rhode Island, Connecticut	3%
South Atlantic States—Delaware, Maryland, Virginia, South Carolina, Georgia, Florida	6%
Southwestern States—Arizona, New Mexico, Texas Oklahoma, Arkansas, Louisiana	6%
Pacific States—California, Oregon, Washington	43%
All other States	42%

These percentages mean that there could be developed, in approximation only, in the New England States, 3 per cent. of 200,000,000 h. p.; and do not necessarily mean that there is in use now 3 per cent. of 6,000,000 h. p. in these States.

No matter what the load, fixed charges on a water-power station remain practically the same. In other words, a water-power plant operates at very little variation in expense from no load to overload. With steam plants there is a much greater variation, as fuel and some labor are saved when power is not being generated.

Water Power Variables

Water power is inferior to steam power, because a river does not flow uniformily throughout the year. A large percentage of the maximum power can be generated only during a few monthly periods when the river is high, and must be sold as secondary or even as tertiary power at low rates per horsepower. Again, river flow is not uniform during successive years, as the dry weeks do not occur always in the same calendar months in consecutive years, so that secondary power cannot be promised in advance. This uncertainty also affects the selling price of power. As interest and depreciation remain the same, irrespective of the quantity of power produced, it is self-evident, when full power cannot be generated, that fixed charges are a large proportion of the selling price of primary power. As secondary power sells at prices from one-half to two-thirds of that for primary, the proportion of fixed charges on secondary power is even heavier. It is still more so on tertiary power.

Steam plants can be located where desired. Water plants cannot be so centrally located, and must have transmission lines which are expensive to maintain. Fuel and labor costs have risen rapidly in the past few years and have brought many water-power projects within reach of successful commercial development.

Investigating Business Chances

Before a water power is developed, careful study should be made of the project to determine whether it will pay. Often the market price at which electric current can be sold, is not enough to cover the cost of generation, transmission, upkeep, fixed charges, and depreciation; and yet it might be advisable to develop a water power by relying on future increase in demand for current and on increase in cost of generating power by other means. Thus, it readily can be seen that there is a large chance for error in making a forecast, and, under all circumstances, proposed developments should be carefully examined and reported on by competent engineers of experience in these matters. A forecast of future business and how a development should be made, are more important than mere estimates of cost of construction. The selling price of hydro-electric power should be lower than that for steam power to meet competition successfully.

Due to variation in river flow and obstruction from ice, etc., the water power available is below the yearly normal for a part of the year and above normal for the balance. Consequently, water-power developments that are designed to meet a fairly steady load are frequently augmented by auxiliary steam plants. These steam plants should be located where fuel can be readily and cheaply delivered.

In this connection, it is well to remember that *reliability* of power is much more important than *cost* to many industries, and that selling price is governed largely by the former.

Study of Stream Regimen

The study of stream regimen to determine the flow available for power development is a very interesting subject and one liable to considerable error if the data are not carefully compiled. The maximum flow of a river is of less interest for power than the minimum flow. It is especially of interest in determining the requisite length of spillway at the dam. When sufficient spillway is not provided, the flow over the crest at times of high flood will produce excessive pressure on the dam and has been a cause for failure. It is good practice to provided an excessive spillway rather than one that is too short.

Obviously, the mean and minimum flows are of most interest. The mean flow selected is one used to determine the size of a development that might profitably be installed. The mean should be for a number of years, and be studied in connection with the minimum. If the actual minimum occurs at very long intervals, it would be safe to use some record higher than the very lowest. The minimum selected is extremely useful in determining the amount of primary power, that is, the amount that can be sold under contract for delivery every day for successive years. This primary power naturally is the most valuable on account of its regularity, and commands the highest price per kilowatt.

The Federal Government and some state authorities have established gauging stations at various points on important streams. These records are of value, when taken in connection with rainfall and watershed areas, in reaching conclusions as to what would be the normal flows at points other than the gauging stations. On the same stream, the records of two or more gauging stations can be interpolated for intermediate points. On other streams, a careful study of the watersheds and rainfall, used with reference to gaugings or adjacent streams, will be the best method in all probability. If there are no gaugings in the neighborhood, additional research work and study of terrain for run-off will have to be undertaken to reach conclusions as to stream flow.

Run-off

While rainfall is a good guide, it cannot be trusted entirely, as the run-off varies through wide limits on different watersheds. It is difficult to determine the true run-off on theoretical considerations alone. The best guide, of course, is actual measurement over a period of years, which unfortunately is not feasible for most projects on account of the time required.

If the data will permit, it is best to arrange each yearly flow in the form of a curve, using ordinates as flows in cubic feet per second, and abscissa as days in the year. Then arrange the daily flows in order of wetness. If only monthly figures are available, arrange the curves in similar manner, that is, the monthly flows in the order of wetness. A mean curve covering a number of years then can be drawn. On this mean curve, have a vertical scale in kilowatts corresponding to flows. The operating capacity of the development would be about that represented between 60 to 65 per cent. of the year. The ordinate of the curve at the percentage of time selected would represent the "flow of development" or the "kilowatt development," and a design for this capacity, in all probability, would be the one best suited to make a fair return on the investment. Special consideration, such as a very uniform streamflow throughout the year, might increase the "flow of development" to over 65 per cent., and vice versa, for some classes of manufacturing industries it might pay to develop to even a greater capacity than that shown at 60 per cent. of the year.

During 60 per cent. of the year, water is running to waste over the spillway, but as this water is only available for a portion of the year and not always for a continuous period, it would not pay to install machinery to use it and have the machinery idle for the remaining 40 per cent. of the year.

Storage

On rivers which have a great variation in flow, storage of water, that is, regulation of flow, will greatly increase the primary power that can be obtained throughout the year. Storage of flood waters, to be released after the stream flow has fallen to some predetermined rate, is expensive and can be carried out only by co-operation of all power users on a stream, or under Federal or State control. A chief expense is the cost of lands to be flooded. These lands frequently contain villages and cemeteries that could be purchased only by condemnation. Cost and difficulty of obtaining flow lands for storage, have delayed the regulation of many important streams.

Federal laws as well as the laws of some states discourage, rather than encourage, a proper hydro-development for the universal benefit of the nation. It must be recognized that power streams are chiefly interstate in their flow; that their tributaries may be also interstate; that their waters are required for potable uses, for irrigation and for navigation, as well as for power; and that power development must not be the sole factor considered. Streams are used for drainage also, and deleterious pollution will be restricted, no doubt, as time progresses and requirements demand.

The country is getting densely settled in certain parts, and industries requiring large amounts of power are centering in localities. Power is needed for such industries and for these densely populated communities. In order to conserve natural resources of coal, wood and oil, and to relieve the railways of unnecessary transportation of fuel, water power can be substituted, but the use of the streams should be along a well thought-out public policy. Such a policy for the use of water—potable, industrial, irrigation, drainage, and power—has not yet been formulated. It is important, therefore, that hydroelectric developments should be studied under a broad aspect of national and state considerations, so that every development of the waters can be made to best serve the need of industries and communities with the least injury to any.

Power Sites on Government Lands

In order to develop many of our streams for their best use, a part of the public domain would be required. Government lands can be used only under revokable permits, and no good plan for recapture has been promulgated. Capital will not develop and then have its work taken from it before it has had a chance to reimburse itself. Special acts of Congress are required whenever a navigable stream is affected. By a suitable arrangement of dams and locks, it would be possible to develop many streams for power generation and make them navigable by canalization. Private capital hesitates to take risks when hampered by recapture clauses, and so far the Government, although wanting the developments, will not assume any share of the hazards.

It would seem possible to have the Government so act as to encourage private development along some pre-arranged plan or policy for the national good. Also, it would seem possible to have the states act in unity so as to assist such a national development and not hamper the situation by petty jealousies. A proper plan or policy would produce cheaper power for the users. The people at large would benefit. Water power is self-continuing, while all the mineral fuels are not. The more we can save our mineral resources of fuel—coal and oil—for auxiliary purposes to aid the water generating stations in dry seasons, the richer and more prosperous will our country be.

Value of Water Powers

There is a universal sentiment that power generated by falling water is always cheap, and, as a corollary, that all water powers are valuable. Those who have studied the matter recognize both the truth and fallacy in this idea. If the potential energy in falling water could be recovered at low cost, the power would undoubtedly be cheap and valuable, the value depending on the nearness of the falls to the market where the

power could be sold. The value of electric energy, like other commodities, depends on the demand and on its cost delivered. Other things being equal, geographical location has an important bearing. An isolated water power, far from any center of demand, cannot be as valuable as one near such a center. For instance, Niagara Falls is extremely valuable as a power-generating fall, but similar falls situated in a desolate uninhabited country would command little or no value. Again, when a number of powers are located in one district, either on the same or adjacent watersheds, and can be electrically connected together and operated as a unit, they have inherent values due to this fact which must be considered when appraising them.

The value of a water power is in reality the sum of the value for water rights and of the reasonable cost of development. Any monetary figure placed on water rights would take into consideration the location of the power, character of the stream, regulation or no regulation, future possibilities, and similar considerations.

Water rights are the rights to make use of the water flowing past an owner's land. If the water cannot be used, there are no water rights. The water rights belong to the land abutting the stream, not only at place where the fall occurs, but also to those lands which are required for pondage.

These rights could be appraised at a figure based on capitalizing the annual saving, if any, by the use of the water to generate power over cost of generating power by other means. A transmission system would come into this consideration, because a steam plant, for instance, with which the water plant would compete, would be located at or near the place where the power would be used. The capitalizing should be at some percentage high enough to cover risks of development and future possibilities of competition.

When no annual saving is shown, water rights can have no present development value, although they may have a future possibility that would entitle them to some value. This con only be determined by careful study on the part of one well qualified to act.

The cost of the development is not a serious matter to estimate. Consideration, however, should be given to whether the development is a proper one and whether it is efficient. For instance, in some localities a wooden dam would be deemed sufficient, while in others a masonry dam with ornamental features would be demanded.

If a development exists which is inefficient, it may reduce value because its removal for better improvements would cost money that would bring in no return on the capital. In fact, there are many developments which could be redeveloped with advantage and any saving in fuel by so doing would be a step toward conservation of national resources.

Conclusion

In conclusion it appears that developed water powers have only one-seventh the capacity of steam plants, while the country's resources are such that the available water power with storage exceeds the present demand for power nearly fivefold. Why not have a nation-wide plan and policy to encourage the use of water power to the fullest extent and conserve mineral fuels, which cannot be replaced, and also relieve the railways from carrying those fuels needlessly long distances?

Some Suggested Changes in Concrete Sidewalk Specifications

By Charles E. De Leuw, of Gates & De Leuw, Engineers, 1742 Monadnock Block, Chicago, Ill.

Concrete sidewalks are probably the simplest construction with which the municipal engineer is ever engaged. Sidewalks are usually constructed as an appurtenance to some major improvement, and in many places they are put in by the local contractors with no supervision whatsoever by the engineer. The average city engineer does not take the design of sidewalks very seriously and is inclined to slide the work through as speedily as possible. The simplicity of the construction is responsible for the lack of attention.

Concrete sidewalks as they are now built will hold together a good term of years. It is true that they buckle, crack, sink and disintegrate in places but it does not cost a great deal to build a new one. However, if we consider the total of the sidewalk construction done in the average city during the average season, we will realize that the volume of the work is sufficient to make it worth while devoting some thought and time to bringing our specifications up to date. This is not intended to be a general indictment of municipal engineers. Their practice has simply been to follow the standards generally accepted on a very minor portion of their work, and the writer has been guilty of the same error of omisssion.

Elimination of Cinder Foundation

When we come to consider the chances for improvement of concrete sidewalk design we find our greatest opportunity in elimination of the cinder foundation. Sidewalk specifications almost always call for a bed of cinders from 6 to 10 ins. in thickness to be laid under the concrete. Why do we use cinders? Does a mass of this material, subject to decomposition in the course of time, provide a more substantial foundation than the soil? Unless it does offer a greater bearing value than the soil, or unless it provides underdrainage not otherwise obtainable, cinders are a useless expense. It would be a difficult matter to find a properly drained soil which has less bearing value per unit of surface than cinders. Sidewalks have very modest requirements as far as bearing value of foundation is concerned so we must look to the matter of drainage to find a *raison d'etre* for the cinder foundation.

Underdrainage og Sidewalks

A bed of coarse cinders, drained and connected properly to a suitable outlet, will admittedly provide splendid underdrainage for sidewalks. While we always find the bed of cinders, how many times do we find any connection, proper or otherwise, to an outlet? With no outlet a cinders bed is useless and in some instances worse than useless. Let us consider the case of a sidewalk to be built in a porous soil: Unless drain tile or an outlet is provided, the porous soil provides the outlet for the water collected in the cinders, the function of the cinders being merely to collect and hold the water until drained off through the soil. In case the walk is to be laid in a dense, compact soil the cinders foundation with no outlet will collect the water and hold it in place underneath the walk, thereby greatly increasing the damage done by freezing and thawing. The contention of the writer is that most soils have sufficient porosity to provide all the underdrainage necessary for concrete sidewalks. In the rare event that the soil is of too fine a texture to provide underdrainage, cinders or gravel should be placed on the subgrade to a depth of 6 ins. and tile outlets provided at the sumps in the sidewalks. These tiles should be led into a catch basin or adjacent gutter.

Expansion Joints

Another thing often neglected in concrete sidewalks is the proper provision for expansion joints. It is common practice to leave a thin joint at 5 or 6 ft. intervals, but experience has shown us that these alone are insufficient. In the course of a few years these narrow slits become completely filled with dirt and debris, which prevent their serving the purposes of expansion joints. Where no other provision for expansion is made, we are certain to find the walks buckling or pushing the curb out at the street intersections. The writer has found that it is wise to place a ½-in. joint the full depth of the walk at 50 ft. intervals. This joint should be filled with some

bituminous filler to prevent the admission of dirt and other non-elastic material.

One Course Concrete Recommended

It is a matter of common knowledge that in the field of Portland cement concrete pavement construction, the two course pavement is practically a thing of the past. As municipal engineers have found one course concrete pavements to be the best practice, so will they find one course cement concrete sidewalks to be the best practice, when they give the matter their attention. The principal defect in the two course walk, is that regardless of the care used in construction, there will always be a plane of weakness between the base and the top. Certainly no method of construction has been devised which will give complete coherence between the two courses. The many existing walks with loose or cracked tops are eloquent testimonials to that fact. Place the same amount of money in a 1-2-3½ one-course Portland cement concrete sidewalk that you now put in your standard sidewalk with its mortar top. You will have less thickness, but much greater strength and longer life.

Summary of Recommendations

To sum up the suggestions given above, the writer recommends: the elimination of the cinders foundation unless the soil is impervious, when some porous foundation should be provided, preferably gravel or crushed stone, and connected up to a good outlet; the placing of ½-in. expansion joints every 50 ft. of walk; the construction of one-course walks. The elimination of the bed of cinders will save a substantial proportion of the cost of this work. The construction of one course work will not save any appreciable amount but will secure more substantial and lasting work. These recommendations are not made unadvisedly. They are made after some study and actual trial by the writer under varied conditions.

Notes on Road Foundations, Drainage and Culverts

By U. W. Christie, County Engineer, Dufferin County, Ontario, Canada

When we consider some recent failures in what were previously considered good roads, the problem of the immediate future is going to be the development of adequate foundations to handle the heavier class of traffic, said Mr. Christie in addressing the recent annual convention of Ontario county road engineers and superintendent.

Failures have largely been the result of weak foundations at the time frost is coming out of the ground, when the water content of the soil is high and foundations are consequently weakened. What degree of weakening is permissible under any conditions before failure is reasonably certain, is not known because we never know, even approximately, the factor of safety in the bearing power of our subgrade.

Moisture Content of Subgrade

Some studies by an engineer interested in public roads give the following interesting data: Clay below a concrete pavement contained 19 per cent. by weight, or about 46 per cent. by volume, of water. In another case clay contained 12.7 per cent. by weight. Clay loam under an asphalt pavement on a 7-in. concrete base contained 13.6 per cent. by weight, or about 33 per cent. by volume, of water. A sand cushion on a concrete base under wood blocks, may contain as high as 12.7 per cent. by weight of water.

The above figures are roughly the natural water content of the various materials under the given conditions.

Movement of Capillary Water

The following table shows the height to which capillary water rises in certain soils in 24 hours:

Light sandy soil	14 ins.
Gravelly soil	16 "
Decomposed granite (loam)	21 "
Heavy granite loam	16 "
Heavy clay loam	11 "
Heavy lava ash	16 "
Pure sand	9 "

In one day the capillary water moves upward about one half its apparent final limit. In three days it moves about two-thirds its apparent final limit. In some soils the movement upwards in the first two hours is as high as one-third of its movement for 30 days. In pure sand it rises in one-half hour approximately one-half as high as in twelve days. The movement is more rapid at the start in light soils, and slows down rapidly. After three days the movement is exceedingly slow in pure sand. In heavy soils the movement is uniformly slower and more sustained. In light soils the per cent. of water in the soil decreases rapidly with the height above the source of water, while in some heavy soils the water content is strikingly uniform at different depths.

Horizontal capillarity occurs with much faster water movement and greater uniformity of moisture content. The speed and distance vary with different soils and ranges from 7 to 33 ft. in the first 24 hours.

Capillary Action

The rapidity with which capillary occurs when there is a free source of water makes it necessary to remove this source with the greatest promptness if a substantial road foundation is to be maintained.

If it is absolutely necessary to allow water to stand or flow along a road embankment for even a few hours, the height of the subgrade above the surface of the water and its distance horizontally from the water source must be considered. Should we have a wetted side drain for only one day at a time, a height of subgrade of 18 ins. will in all probability be sufficient, and should the horizontal distance to the drain be large the 18 ins. may be reduced, but if the wetted side drain is to remain for a considerable time the height might have to be increased as much as two or three times the above figure.

Surface Drainage

The road builder should not only strive to get the water out of the road foundation into the side ditches as quickly as possible, but he should also strive to get the water out of the side ditches and off the road as quickly as possible.

Culverts should be built at low points and ditches should be constructed with a uniform grade to and from them, both culverts and ditches should be kept free of all obstructions that will impede the free flow of water. A special effort should be made each fall to remove all trash and debris collected at entrances and outlets of culverts.

A Dry Subgrade

A dry subgrade is a good foundation for almost any of the ordinary bases if it be properly shaped and rolled prior to surfacing. Thus a ridge road is always a good road with a side hill road, if proper outlets are opened, a close second, the secret being that they are easily drained and, consequently, are generally either naturally or artificially sufficiently drained. On the other hand a swamp road is invariably a bad road, as nature has not provided for a dry subgrade and artificial drainage is difficult and expensive, and in the past has been greatly neglected. In many cases a canal or canals have been dug along the side or sides of the road, and these though they have no proper outlets, are used as dumping grounds for the neighboring farms. Before road construction is attempted such drains must be carried to outlets and if the water cannot be lowered sufficiently a foundation not seriously affected by capillary must be built. Such a foundation might consist of a layer or two of field stone, 8 to 12 ins. thick, covered with crushed stone or coarse screened gravel. Probably

a telford foundation would be better, but hand placing of stones is a tedious and expensive job and, at the present prices of labor, is, except in extreme cases, not warranted. If the conditions be somewhat more favorable and the traffic not too heavy, a layer of from 4 to 6 ins. of coarse crushed stone might be sufficient. In any case tile sub-drains must be placed at intervals, depending upon conditions, leading to the side ditches, and if these sub-drains are not too expensive they cannot be too frequent. On side hills which are wet one tile drain 4 or 6 ins. in diameter, placed on the high side at a depth of 3 or 3½ ft. and bedded in gravel will usually be sufficient, but on wet cuts, two side drains will be required.

Vehicle Load on Roads

If we consider the maximum load allowed on county roads, that is a vehicle weighing 12 tons with a maximum pressure of 650 lbs. per inch of tire width and that two-thirds of the load or 8 tons are carried on the rear axle, we have a weight of 4 tons per rear wheel which would require a tire width of over 12 ins. Now if we assume that the pressure is carried downward at an angle of 30 degrees with the vertical, and that a gravel subsoil will support 8 tons per square foot, firm clay, 4 tons per square foot, damp clay, 2 tons per square foot, wet clay, 1 ton per square foot, and wet yielding soil only ½ ton per square foot, we would require a depth of crushed stone of approximately 3½, 6, 9½, 16¼, and 25 ins., respectively, in addition to the wearing surface.

In the last two cases a condition is met, which requires special consideration. If this heavy class of vehicular traffic were very limited it appears that the reasonable thing to do would be to prohibit its use on the road during wet seasons. On the other hand if this heavy vehicular traffic represented a fair proportion of traffic it would appear that the road should be made to accommodate it. Special draining should be resorted to or it might even be necessary practically to bridge the soft places by using a telford base.

The cross-section of the road should be continually changed to meet continually changing conditions of subgrade.

Location and Size of Culverts

Culverts are placed on the line of natural or artificial watercourses and generally at right angles to the center line of highway as this saves in cost. It is not good practice to place all culverts at right angles to the center of the road as there are conditions arising in which such an arrangement would not at all apply to the drainage requirements, and it is well to remember that the object of a drain is to facilitate drainage and a culvert being part of a drain, has like duties to perform.

It is not safe to depend upon any general simple rule to determine the size of a culvert as conditions are so different. The size depends upon the rate of rainfall, the extent of area drained, the rate of slope, the character of the soil, the shape of the area, the presence or absence of bush, and the season. A small area will require a proportionately larger culvert than a larger area, a circular or square drainage area will require a larger culvert than a longer narrow area. A well defined valley requires a larger culvert than one consisting of a flat slope. In warm weather the size depends upon the porosity of the soil and the extent of evaporation. On sandy soils 30 to 50 per cent only of the rainfall will reach the culvert and on heavy clays, 90 to 100 per cent. Long, heavy rains will saturate any soil until nearly the entire rainfall will run off. Frozen ground will give 100 per cent. run-off, to which should be added allowance for rain melting snow. If all the rain falling on an area reaches a culvert in 30 minutes and if the maximum rainfall recorded in 30 minutes is ¾ in., the rate of rainfall to use in designing a culvert for that area, would be a rainfall of 1½ ins. per hour.

Small Culverts

Small culverts are usually pipe, either cement, vitrified clay, cast iron or corrugated metal, with an upper limiting size of about 30 ins. diameter though much larger sizes may be procured. Be sure to lay all pipe with a grade dropping to the down-stream end and that the conditions at the lower end of the culvert will carry off water as fast as the culvert discharges. All pipes should have a covering of at least 1 ft., and where the traffic is heavy the covering should be at least 2 ft. If the fill is not less than 2 ft. or more than 10 ft., double strength vitrified sewer pipe may be used; these are made in lengths of 2, 2½ or 3 ft.

If the soil is firm, for pipe up to 15 ins. in diameter, excavate about 1 ft. wider than the over all diameter of the pipe and about 8 ins. below grade. Fill the extra excavation with well-packed gravel and bed the pipe thereon, being sure to secure a proper bearing throughout the entire length of pipe. Lay the pipe to the true line and grade, beginning at the down-stream end and facing the bell ends up stream. Caulk joints with oakum and fill in the remainder of the joint with a mixture of 1:1 sand and cement. In back filling place the material in thin horizontal layers and tamp well under and for some distance above the half height of pipe, but be careful not to tamp too much just above the pipe. For pipe 15 ins. in diameter and over, excavate about 3 ins. below the bottom of the pipe and about 6 ins. wider than the outside diameter of pipe and place and joint as for smaller pipe, but fill the extra excavated space with concrete of the proportion of 1 cement, 3 sand and 5 screened gravel with no stones exceeding 1½ in. in largest dimension or if suitable pit run gravel is available use in proportion of 1:6. The pipe must be bedded on the concrete and the concrete well packed around the pipe and brought to the half height of pipe filling the entire excavation. Above the half height of pipe it slopes up to top of pipe where it has a minimum thickness of 3 ins. above the pipe. For a 15-in. pipe this requires slightly over 5 yds. of concrete to the 100 ft. of culvert. Cast iron pipes, on account of their great weight and present cost, are not much used.

Metal Pipe Culverts

Corrugated metal culverts are much used in highway construction, as corrugation gives a very high strength in proportion to the weight of material. They are made in sizes from 8 to 84 ins. in diameter and in two styles, semi-circumference section and complete circumference section in lengths up to 40 ft. Longer lengths are obtained by fastening two lengths together by using corrugated metal collars supplied by the makers. All corrugated culverts should be galvanized.

All pipe culverts are better if provided with cement concrete end walls which should in general extend two feet below the invert of the pipe and reach to a height above the pipe to hold back a fill with a side slope of 1½:1. Such a wall at the end of an 8 in. pipe would be 4 ft. 2 ins. long, and would contain 0.77 cu. yd., at the end of a 10 in. pipe would be 4 ft. 10 ins. long, and would contain 0.92 cu. yd., at the end of a 12 in. pipe would be 5 ft. 6 ins. long and would contain 1.08 cu. yds. and at the end of a 16 in. pipe would be 6 ft. 10 ins. long and would contain 1.42 cu yds.

Concrete Culverts

Probably the best material for culverts over a 2 or 3 ft. span is reinforced concrete. A combination of steel and concrete constitutes a form of construction possessing to a large degree the advantages of both materials without their disadvantages. Steel is a material specially well suited to resist tensile stresses, and for such purposes the most economical form—the solid compact bar—is well adapted. To resist compressive stresses steel must be made into more expensive forms, consisting of relatively thin parts widely spread, in order to provide the necessary lateral rigidity. A serious disadvantage in the use of steel in many localities is its lack of durability.

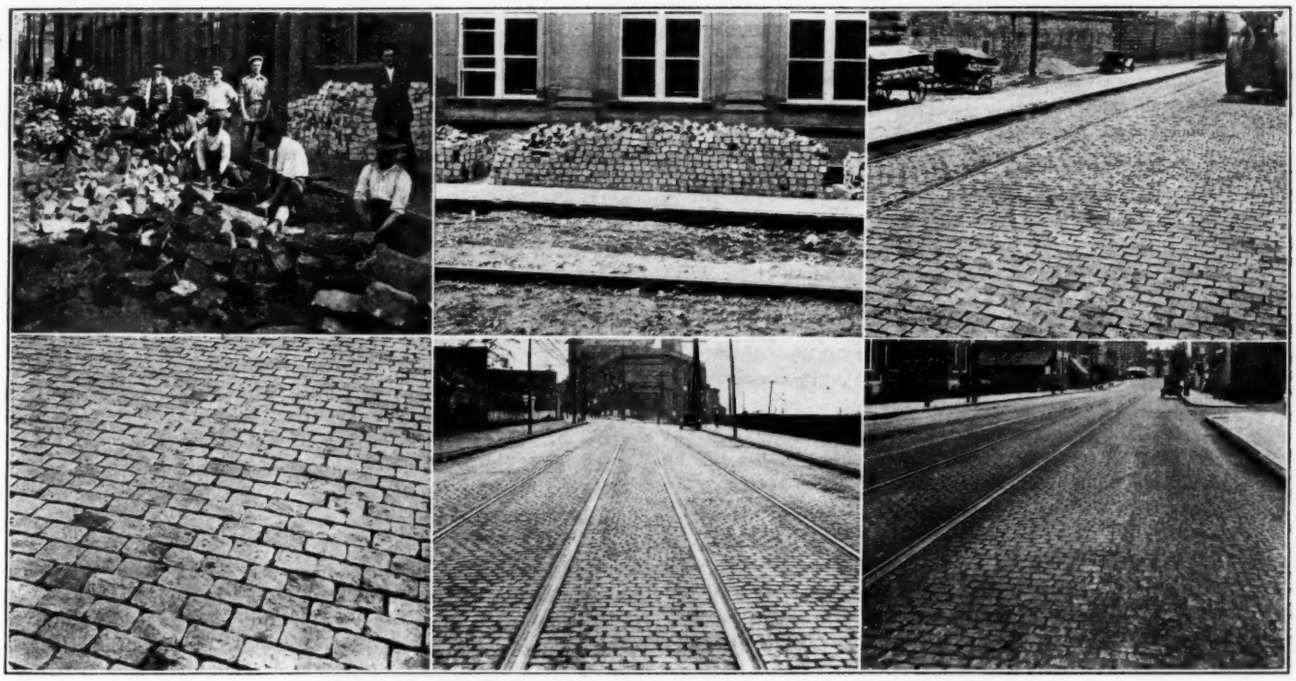
Concrete is characterized by low tensile strength, relatively high compressive strength, and great durability. It is also found that steel well covered by concrete is thoroughly protected from corrosion. Concrete is also a comparatively cheap material and is readily available is most localities.

The Design and Construction of Granite Block Pavements in Cincinnati

By H. F. Shipley, Principal Assistant City Engineer in Charge of Highways, City Hall, Cincinnati, Ohio

Granite has been extensively used as a paving material in Cincinnati for the past 34 years, the first granite block streets having been laid in 1885. Up to that time the only hard surface roadways which had attained any general use were macadam and cobblestone paving or "Bowlder Paving" as locally named.

Macadam composed of native limestone was used on practically all suburban and residential streets, while the cobblestone paving had come to nearly universal use on all streets in the business portions of the City. Both these forms of pavement survive in Cincinnati; macadam, although frowned upon by city officials, is still favored by developers of suburban property on account of cheapness; bowlder paving is scarcely ever used on new work.



VIEWS OF GRANITE BLOCK PAVEMENTS IN CINCINNATI, OHIO.

Top Row: Block-makers Recutting Blocks on Eastern Avenue in 1919—Recut Blocks Piled on Sidewalks on Eastern Avenue in 1919—Pavement of Recut Blocks on Eastern Avenue in 1919, Before Rolling or Filling Joints. Bottom Row: Close up of Preceding View—Pearl Street Paved with Recut Blocks in 1916—Colerain Avenue Paved with Recut Blocks in 1915.

Early Granite Pavements in Cincinnati

The granite blocks for the first paving laid in Cincinnati were obtained from various sources, some from Missouri, some from New England, some from Virginia and some from North Carolina, but in a very few years the development of the Georgia quarries around Lithonia practically drove all other granites out of the local market both on account of the ease with which the Georgia product can be worked and on account of favorable shipping facilities and freight rates. The only other granite which has had any considerable use here since the Georgia granite came into use is that from Mt. Airy, North Carolina, and this has been used to a small extent compared to the Lithonia granite.

From the begnning of granite paving in this City until about 1910 there was little or no change in the general character of the work. The blocks were large size, being from 12 to 14 ins. long, 4 to 6 ins. wide and 6½ to 7½ ins. deep. The best of the blocks were fairly well dressed but a considerable percentage was rough and of size differing greatly from the average. The base consisted of 6 ins. of natural (Louisville) cement concrete made of large stone and surfaced on top in only a rough fashion. The bed consisted of sand varying from 2 to 3 ins. in depth. The joints which averaged about ¾ in. and often exceed 1 in. were filled with pebbles and then poured with coal tar pitch. The pitch usually penetrated the pebbles to a small depth only. There was a general opinion that granite paving was durable, but a well-grounded certainty that it was rough and noisy.

Changes Introduced in 1910

In 1910 steps were taken to modify radically the character of our granite paving. A smaller block was adopted and the inspection as to uniformity and trueness of dressing was made much more rigid. A base of Portland Cement Concrete was provided, smooth and true to proper grade, the blocks were placed on a thinner sand bed with close joints and with stringent requirements as to getting the joints poured in such manner that the pitch penetrated deeply into the pebbles so as to produce water tight joints. Rolling by steam roller was substituted for ramming as previously practiced.

Bituminous Filler Now Used Again

Up to 1912 paving pitch and pebbles had been exclusively used as joint filler, but at that time cement grout as a filler came into favor and was largely but not exclusively used during 1912 -13-14 and 15 since which time we have swung back to the bituminous filler for the larger portion of our work.

Present Specifications

Our present specifications require that the blocks shall be not less than 7 nor more than 10 ins. in length, not less than 3½ nor more than 4½ ins. in width and not less than 4¾ nor more than 5¼ ins. in depth. The blocks are divided by width in two classes; blocks 4 ins. wide and over are classed as thick block, those under 4 ins. as thin block. It is required that the two classes be used on different portions of the work, and with this end in view it is required that the two sizes be separated at the quarry and shipped in separate cars.

This separtion of the sizes is a source of continual dispute

and trouble on the work, as the Contractor's men are constantly getting the two sizes mixed. The trouble we have in this regard led us at one time to specify that the blocks should not vary more than ½ in. in width between the limits of 3¾ and 4¼ ins. but the quarry people claimed that it was not possible to fill this specification without such a large percentage of culls that the cost of the paving would become prohibitive, and we therefore abandoned this requirement in favor of the allowance of 3½ to 4½ ins.

Thick Blocks Superior to Thin in Dressing

It has been our experience that under such a specification the thin blocks are distinctly inferior in dressing to the thick blocks. This is probably due to the way the blocks are handled commercially at the quarry. The operator pays the block-makers so much a thousand for making the blocks, but sells them to the contractors for so much a square yard in the street. It being therefore to the operator's advantage to have blocks of the maximum permissible size, he requires the block maker in getting out the blocks to aim at the maximum, rather than the average size. This results in the narrow class containing the larger number of irregular blocks, because this class contains those which split too narrow to begin with and those which split too wide and which are trimmed down on this account. Blocks which split irregularly can never by subsequent dressing, be made as smooth and perfect, except at excessive cost.

Base and Paving Bed

Much greater care is taken at the present time to see that the top of the concrete base is exactly parallel to the paving surface and the sand cushion is specified to be 1 in. in depth instead of two as formerly. While our general specifications provide for the use of sand-cement bed, if required, this practice although of several years standing for brick and wood block paving, has never been enforced for granite paving. We have noted the opinion of many engineers as to the shifting of sand-bed, and have seen plenty of evidence of this in the older paving, but in the work laid the past five or six years where the joints are completely filled with either cement grout or paving pitch and pebbles, we have been able to detect no signs of weakness which can be attributed to the sand bed and have therefore been unwilling to go to the extra expense and trouble of paving on the sand-cement bed. It is possible that further experience may cause us to change our opinion in this respect.

Rolling Instead of Ramming

Several years ago, about the time of general revision of pavement specifications, we adopted the practice of rolling granite pavement with steam roller as a substitute for hand ramming, and this has remained our practice ever since. The advantages of rolling are that every block is reached and bedded, and that the surface grade is truer and smoother than appeared to be possible with hand ramming. This disadvantage of rolling is that there is a very considerable tendency to tilt the blocks and disarrange the paving unless the joints are well filled with pebbles, and this latter practice is fatal to a thorough subsequent filling of the joints with grout or bitumen. On this account we have been considering lately the advisability of going back to hand ramming instead of rolling and probably would do so if we can develop rammermen of sufficient skill and conscientiousness to do a thorougly workmanlike job in this respect.

Joint Filling

The thorough filling of the joints between the blocks is one of the vital requirements of granite paving. Opinion is divided as to the merits of cement grout and bituminous joints and it is well recognized that both kinds of joints have advantages and disadvantages. The cement joints protect the edges of the blocks and hold them firmly to grade better than any bituminous joint. On much used thoroughfares (and streets paved with granite are always such) we find that it is exceedingly difficult to keep traffic off the pavement after being laid the length of time necessary for good results with grout; in fact on our narrow and busy streets we have found this practically impossible. The necessary wait while grout is curing, besides its inconvenience results in considerable delays in the prosecution of the work. When cuts have to be made in the street subsequent to paving the expense of repaving is greatly increased owing to the great loss of blocks broken in being taken up, and it is also very expensive, tedious and often impracticable to keep the repaved places barricaded and guarded the required time for curing.

Grouting is a process with scarcely any factor of safety in the way of slightly inferior work; it demands absolute perfection in every stage. No matter how careful the inspection there may be some places and some batches not quite up to the standard and these result in weak places unable to withstand the tremendous stresses set up in solidly cemented surfaces. All such places soon manifest themselves by cracking, breaking and spalling of the blocks and holes soon result expensive to repair and practically impossible ever to be made as good as the balance of the street. In this city the present practice has been to wash out the pebbles about one-half way down from the tops of the blocks after rolling and before grouting. This is done by a stream of water from a hose with a nozzle. We then give a first coat of grout of neat cement and follow with one or two coats of one to one mixture. The first coat of neat cement is a departure from former practice and is expensive but seems to be very effective in overcoming some of the difficulties we have experienced with grouted pavements.

In the bituminous joint we have gone through a gradual evolution. In former times we merely filled the joints with pebbles to a depth 1 in. from the top and poured in the paving pitch; next we filled the joints only slightly over half full with pebbles and then we poured the pitch to the top; next, after filling the joint half full with pebbles we poured the pitch, added more pebbles and poured again and then added a covering of torpedo sand. This we called doubled pebbled and doubled poured work and it produced a very good joint if conscientiously carried out. Our next improvement was to give a light coat of pebbles after the second pouring, squeegee a flush coat of pitch over the entire surface and then cover with torpedo sand; this we call "Pitch Filler and Flush Coat" and it is a most excellent process. This year we have adopted the pitch-mastic method in which we mix equal parts of hot fine sand and hot pitch and squeegee into the joints; preliminary to the application of the pitch-mastic we see that the pebbles are raked out half way down the joints and pour the joints with straight pitch to the tops of the pebbles. We do not favor the pitch-mastic method without this preliminary pouring.

We are not entirely certain that this will produce a better joint than the "Pitch Filler and Flush Coat" method but it looks very good so far. It is our experience that pitch for granite paving must be of quite low melting point. We are using it around 110 degress and this makes it necessary that as much mineral matter as possible be incorporated.

Re-Cut and Redressed Blocks

Several years ago some of the old granite streets were taken up and repaved. In this work the depressions were merely filled with sand, the blocks repaved and the joints grouted with cement. This gave us a pavement considerably better than the old one which was full of holes and depressions but by no means a pavement suitable for modern conditions. Neither did it have great lasting qualities as the sand bed was altogether too thick and non-uniform, also as the old blocks were badly rounded at the edges, the grout filler ran out to feather edges on the blocks and soon began to chip off. In taking up the old blocks preliminary to this repairing, it was found that while the edges were worn the blocks as a

whole had lost very little depth after 25 years service. This led us to adopt the method of recutting the blocks before repaving. The old blocks are as a rule about 12 ins. in length and 6 to 7 ins. in depth; in recutting they are napped in two transversely to the original length, the napped planes forming the paving faces for the new blocks. The blocks are then trimmed all around with reel until we have a block about 6 ins. long, 5 ins. deep and from 3½ to 5 ins. wide which when paved and produce a remarkably smooth and pleasing surface; new blocks have to be extremely well shaped and well dressed to make as good a surface. Before paving we clean off the old concrete base which we usually find to be extremely rough and uneven and give it a "skim" coat of fresh concrete varying in depth from 1 to 5 ins. The surface of the new concrete is 6¼ ins. below and parallel to the new paving surface and the balance of the work proceeds as in new granite paving. It is found that many of the old stones are so rough and defective that it is not possible to form good recut blocks from them and this results in a deficiency which has to be supplied by new blocks. This deficiency has varied on different streets from 18 per cent. to 35 per cent. of the total area depending on quality of old stones. At the time when most of our work of this kind was done the going price for new granite paving was $3 per square yard and for the recut block paving the price was about $1.75 so that figuring on a basis of 75 per cent. recut to 25 per cent. new the resulting pavement cost on an average of $2.06 per square yard. At the present time prices are about 35 per cent. higher.

Efficient Control of Small Sewage Treatment Works

In the control of small sewage treatment works, as in large ones, efficiency in combination with economy is the goal to be arrived at, said James H. Edmonson in addressing the Institution of Municipal Engineers of Great Britain.

The author has frequently seen when visiting sewage works that the effluents leaving small works are infinitely better than those leaving larger ones—in fact, in the author's opinion, many of the effluents are too good, if such can be the case, and consequently economy must have suffered to attain this high degree of purity. This probably arises through insufficient knowledge of the sewage treated and effluent obtained, and consequently the sewage has been put through more processes or treated on a larger area than is really necessary to produce a satisfactory and stable effluent. If, however, systematic records, not necessarily of a highly technical character, were kept, they would be of great assistance in determining any further treatment, and also satisfy those responsible of the results obtained day by day.

Measurement of Sewage Flow

The quantity of sewage delivered at the disposal works is of the first importance. This is fairly simple to determine on a small works without going to the expense of fixing a recorder. Good approximate results can be obtained by the use of a rectangular weir or V-notch, and recording the depth flowing over same every hour or half-hour. The effluent can also be recorded by fixing a rectangular weir at the outfall from each channel or main channel from the filters, as at the Southall works.

The quantity of tank effluent each bed, filter or plot of land treats can often be approximately estimated by recording the number of hours each unit works per day, providing a practical test has been previously carried out of the quantity each unit treats per hour. In cases where pumping is necessary, the time the pumps are at work usually gives a true record of the flow, any appreciable increase being due either to loss of efficiency of the pumps or increase in flow.

Measurement of Sludge

The measurement of the sludge at the time of cleaning the tanks—which is easily accomplished—along with the number of days such tank has been at work, is of considerable value. Any appreciable increase may be due to increase of flow, which should be accounted for above or increased strength of sewage. On the other hand, should there be an increased flow of sewage delivered at the works while the production of sludge is normal, of course eliminating storm water, it will probably be found to be due to subsoil water leaking into the sewers or some other sudden discharge into the sewers.

These, with many others, which are particularly adapted to individual works, are common-sense records, and are no doubt kept by many. There are in addition, however, a few chemical and physical tests which can easily be applied, and in conjunction with the above records will enable one to have a small works under thorough control.

Refined and Approximate Analysis

You will no doubt be familiar with the items of analysis the analyst presents when reporting on the examination of a sample of sewage. The results given are usually expressed in parts per 100,000, and even then some of the figures are small decimals, which can hardly be arrived at by simple or rough-and-ready methods. There are methods, however, which approximate to one or two of the tests if not the figures. One of the principal tests which can be so approximated is the 4-hour's oxygen absorption test. This is carried out by placing a known quantity of the sample under examination in a standard solution of acidified potassium permanganate (containing available oxygen) which will oxidize any organic matter present. As is well known, potassium permanganate solution has a brilliant purple color, which gradually disappears with the loss of its available oxygen, being colorless when all the oxygen has been absorbed. Upon this characteristic a simple test has been devised. Other tests are presence of nitrates, turbidity, odor and stability, which will be briefly described along with the necessary chemicals and apparatus, which can be obtained at a very nominal cost.

Some Simple Tests

Oxygen Absorbed.—Apparatus and chemicals required: One pair of apothecary's scales, one or two weights totalling 0.4 gramme, one litre graduated flask, 10 c.c., 25 c.c. and 100 c.c. graduated cylinders, pure sulphuric acid, potassium permanganate, and a stock (6-8 oz.) of stoppered bottles.

Solution.—Weigh out on the scales of 0.4 gramme of potassium permanganate, and place in litre graduated flask, and dissolve in a little good tap water; add 100 c.c. of sulphuric acid and allow to cool. When cool, make up to the litre mark with water.

Method.—Place in a stoppered bottle 100 c.c. of sample to be examined and add 10 c.c. of the acidified solution of potassium permanganate. Note how long it takes for the color to entirely disappear. With crude sewage this may occur in a few minutes; with a good effluent it may take some hours.

Presence of Nitrates in the Effluent.—Apparatus and chemicals required: One Nessler tube, a solution of 1 per cent. brucine sulphate and sulphuric acid. Place 5 c.c. of effluent in the Nessler tube and add 2½ c.c. of brucine solution, thoroughly mix and add 2½ c.c. of strong sulphuric acid down the side of the tube, which will settle at the bottom. If a pink zone forms, gradually changing to amber, nitrates are present—the more marked the reaction the more nitrate present.

Turbidity.—Apparatus required: Piece of white cardboard with black lines ruled across, a ground bottom Nessler tube at least 6 in. in height and 1 in. in diameter, graduated up the side. Shake the sample thoroughly and slowly pour into the Nessler tube, which is placed on the paper, until the black

lines are obscured. A satisfactory effluent should show a depth of 4 or more inches.

Should Have No Offensive Odor

Odor and Stability.—Apparatus and chemical required: stoppered bottles and a solution of methylene blue. A good effluent should have no offensive odor at the time of sampling or even after being kept in a stoppered bottle in absence of air for four to six days at a temperature of 80 degrees F. The stability can be estimated by tinting the sample in the bottle with about six drops of methylene blue solution before placing on one side or in an incubator. Examine the sample daily, and should the color persist until the fourth day one can be satisfied of the stability of the sample. If an effluent has a deficiency of dissolved oxygen and nitrates it is invariably found that it is charged with an excess of organic matter, and consequently will be found to be unstable, emitting a disagreeable odor, and discoloring methylene blue upon incubation. If the color persists for four days it is usual to record it on the record sheet with a + sign; if it disappears within four days with a — sign.

While advising that such records and elementary tests would prove of great assistance in the control of small works, and which can easily be carried out by any intelligent workman, the author would certainly recommend that periodical samples be submitted to an analyst and his report compared with the results obtained on the works. By such means the manipulator could fix his own limitations to the elementary tests just described.

Conclusion

In conclusion it may be mentioned that in considering an analyst's report the following four tests are usually taken as standards:

1. The 4-Hours' Oxygen Absorption Test.—A permissible effluent should absorb less than 1.40 parts per 100,000; a good effluent under 1.0 part.

2. The Albuminoid Ammonia Test.—A permissible effluent should contain less than 0.10 part.

3. Suspended Solids.—The Royal Commission recommends that a final effluent should contain less than 3.0 parts per 100,000.

4. Dissolved Oxygen Test (oxygen absorbed from tap water in five days at 65 degrees F.)—The Royal Commission recommends that a final effluent should not absorb more than 2.0 parts of oxygen per 100,000.

Organization of the Asphalt Association

Representatives of the principal asphalt producing companies of the United States and Canada have completed the organization of an association, the name of which is to be "The Asphalt Association." Its purpose will be to disseminate information pertaining to the uses of asphalt with particular reference to highway and street paving, cooperating with city, county and municipal officials and with scientific bodies and colleges seeking to bring about the most effective methods in the use of this well-known material.

The officers elected for the ensuing year, are as follows: President, J. R. Draney; Vice President, W. W. MacFarland, and Treasurer, N. G. M. Luykx.

The Secretary, who will be the active officer in charge of the affairs of the association, is J. E. Pennybacker, formerly Chief of Management of the U. S. Bureau of Public Roads and during the war period, Secretary of the U. S. Highways Council.

The New York office will be located at No. 15 Maiden Lane. Other offices will be established soon at Chicago and Atlanta and ultimately in Canada and other cities in the United States.

With city and highway expenditures for this, and next year, estimated to reach in the vicinity of a billion dollars, asphalt, a most important constituent in the construction and maintenance of roads, is attracting wide-spread attention.

Personnel

Prominent federal, state and municipal engineers are included in the staff of the Asphalt Association. There will be a Research and Technical Department managed by Prevost Hubbard, Chief of the Research and Testing Division of the United States Bureau of Public Roads prior to his affiliation with the Association. Mr. Hubbard is one of the foremost authorities in the United States on research work in all classes of bituminous materials and is the author of standard text books on the subject. He is also thoroughly conversant with the nature and uses of all other road materials as their study and development came directly under his control in connection with his government duties.

Field Engineers who will devote their attention to aiding State, county and municipal authorities in the working out of their highway problems, include Fred W. Sarr who was Deputy State Highway Commissioner of New York in charge of the maintenance, repair and reconstruction of all State and county highways comprised in New York's great system. No engineer in this country has had a closer insight into the questions of durability of types of highways, the service conditions which highways must withstand, and the relative cost of capital outlay and up-keep of all types of highways than Mr. Sarr, during his past 20 years.

A. T. Rhodes for years Street Commissioner of Worcester, Mass., and later Field Secretary of the Granite Paving Block Manufacturers Association and, who is Vice President of the Massachusetts Highway Association will look after the New England territory and other eastern points. Mr. Rhodes' practical experiences include the design and installation of the city asphalt plant at Worcester and the construction of the asphalt pavements of that city. His general engineering experience has familiarized him with all types of highways.

At the Chicago office of the Association, J. B. Hittell, formerly City Engineer of Chicago and President of the Illinois Society of Engineers will be in charge of the work of the Association in the middle western states. Mr. Hittell is admittedly one of America's foremost engineers and has made an enviable record in municipal work.

Shortly a branch office will be established in Atlanta and at other points and announcements will be made of the engineers selected for the various posts.

Asphalt Surfacing of Old Macadam Roads

Saving the many thousand miles of waterbound macadam roads on main routes of travel by utilizing the existing surfaces for foundations will be a field in which the interests of the tax payers and the furtherance of the asphalt industry will happily be the same. Digging up old macadam roads and disregarding the materials thus assembled at a cost of millions of dollars is a form of extravagant waste which it is a patriotic duty to prevent.

Lines of Activity of the Association

Utilizing local materials to the fullest extent in combination with asphalt should yield immense savings to tax payers by cutting down freight costs on imported materials. This phase of construction will also be given close attention by the Association.

Improvement in methods, speeding up of deliveries, betterment of product, aiding the working out of thorough inspection facilities, obtaining and giving out useful data to the public officials, engineers and contractors will form some of the other lines of activity of the organization.

Garbage Disposal by Feeding Successfully Practiced at Lansing, Michigan

By E. C. W. Schubel, D. V. S., Superintendent Garbage Department and Hog Farm, Lansing, Mich.

The method of collection being carried out in Lansing is what may be called the "can collection" system—the collector takes up the full can and leaves an empty one. This system is an advantage to the householders because they have no cans to wash, but is undesirable to the city from the standpoint of economy. It costs the city more than $1,500 a year to wash and disinfect the cans.

The can collection has another disadvantage because a great many householders are very indiscreet in what they place into the garbage can. They place such articles as glass, broken crockery, floor sweepings and tin cans into the cans with the garbage. This cannot be detected until the cans are emptied at the disposal place.

Handling the cans so often causes a rapid depreciation. The city is buying the cans at present from funds derived by making a rental charge of $1 per can per year. Many cans will not last a year. Freezing weather causes the greatest depreciation on cans.

A tank collection which is being contemplated before the next fiscal year will eliminate this mixture of garbage and rubbish, decrease the cost of collection and give more frequent service.

On account of the increase of requests for service since the close of the war and the increased activity in building operations, the equipment is so limited that only weekly collection is being given to the residental sections of the city while daily collections are given to the restaurants, hotels, cafes and other eating places.

Collection with Motor Equipment

The collection is made entirely with motor equipment. It includes one Duplex 4-wheel drive truck with a 3½ ton capacity, with a trailer of like capacity. When the truck is used for collection purposes, it will carry from 150 to 200 cans, but when used for transporting the cans of garbage from the city to the farm it will haul from 350 to 500 cans when using the trailer. This mode of transporting the garbage is used in winter or when the roads are impassable for the smaller trucks.

The equipment also includes two 1-ton Ford trucks with a capacity of each for 55 cans; two 2-ton Reo trucks with a capacity of each for 115 cans; and one 1-ton Republic with a capacity of 60 cans. To this equipment there will be added one or two more trucks during the coming year.

On the Duplex truck, three men are used for collection. On the other trucks only two men are used. At the present time, the collection is being made with eleven men.

VIEWS SHOWING THE DISPOSAL OF GARBAGE AT LANSING, MICH., BY FEEDING TO HOGS.

Top Row: A type of the 2-Ton Motor Truck used for collection. The Stack Can or Can with Flaring Top is used as it is considered the best type—Shows the possibilities of Ground Feeding, especially on Sandy Soil which gives good Drainage and absorbs the Excess Water in the Garbage. Bottom Row: Providing a Wallow of Fresh Water. Unclean Wallows are conducive to Disease—These Feeders made 105 Pounds Gain from February 15 to June 19. They Sunned themselves on Sand Hill during Cold and Muddy Season and were ready for Market One Month before the rest of the carload.

The service is becoming more general as those people living in the outskirts of the city are beginning to ask for service. It shows that people are beginning to be educated to want better sanitary conditions.

Garbage Fed to Hogs

The garbage from the city is being fed to hogs. This method of disposal has been highly satisfactory and very profitable considering the investment.

The idea of feeding the garbage to hogs was brought to a realization by a number of our public-spirited citizens, including former mayor, J. G. Reutter, Alderman Lewis Neller, Alderman John McClellan and Ex-Alderman Frank Young, who backed the proposition with their money.

Feeding Found Profitable

After the proposition proved a financial success, they turned over to the city on November 1, 1917, a herd of hogs numbering 213 valued at $4,000 and several buildings valued

at $1,000. Since that time additional buildings and equipment costing over $1,200 have been purchased, the herd increased to 400 hogs valued at over $12,000 and $5,000 in the treasury with which to buy more hogs. Building up the herd has been entirely dependent upon the profits derived from the sale of hogs.

A report compiled recently by the city comptroller showed that on May 1, 1919, the project had made a profit of about $8,500. This was based on a price of about $18 per hundred pounds for the hogs, when in reality the hogs could have been sold for $20 per hundred pounds. If a sale had been made of all hogs on hand, the profit for the past fiscal year would have been more than $10,000.

As soon as the herd can be increased to 800 or 1,000 head and kept at about that number, the profit from feeding will be from $12,000 to $18,000, dependent, of course, upon a high price for hogs. There is every indication that the demand will be enormous from the European countries for years, as it will take those countries a number of years to build up their herds again.

Those cities boasting of other methods of disposal cannot show much greater profits when the investment is considered.

Ground Feeding Preferred

When a farm is purchased where the feeding may be done upon the ground, the uneaten portion of the garbage will be converted into fertilizer by plowing it under the soil and then sowing a crop on this ground. This will increase the profits from garbage disposal.

The garbage is fed as it comes from the city directly to the hogs upon the ground or upon cement platforms.

Feeding upon the ground is preferable as upon platforms a certain amount remains uneaten and so must be hauled away while that which remains upon the ground uneaten may be plowed under.

The test of the practicability of the feeding method of disposal is the selling possibilities of the pork produced. There is no benefit in feeding if the pork is unfit for food or if a popular prejudice will prohibit it from selling freely.

There is undoubtedly a prejudice in the public mind against "garbage"—not particularly against garbage-fed pork, nor reduction or incineration plants, but against the word "garbage,, and anything connected with garbage. One might say its disposal was regarded as an illicit business. It is not strange therefore that there is so little general knowledge of the possibilities of garbage utilization and particularly of the feeding method.

If garbage-fed pork is inferior to grain-fed, the price paid by the packers, who are naturally adverse to paying full price for an inferior product, should indicate the fact. When selling our hogs to the Detroit market, they have always brought the top of the market.

I have never seen any market which discriminated against hogs fed upon garbage. When cases of "softer" pork have been noted, it has generally been found that the animals were improperly raised.

An objection often raised to garbage-fed hogs is that such hogs are likely to be infected with trichinosis or tuberculosis. There are no data available to support such claims; isolated cases have been found, as with grain-fed stock, but this is no evidence that garbage-fed hogs, as a class, are any more susceptible to either trichinosis or tuberculosis than grain-fed.

Rate of Garbage Consumption

About one hundred animals, ranging from pigs to big sows, will eat a ton of garbage per day. This means an average of 20 pounds per animal per day.

At this time of the year, hogs make very good gains in weight. Under proper conditions, they will gain from ½ to 1 pound, and even more, per day. A carload marketed in Detroit last week gained a little more than 100 lbs. from the middle of February to the 19th of June or about 125 days. This time included some very bad weather for hogs.

Householders should be required to keep garbage free from cans, papers, sawdust, oyster shells, glass, etc. Garbage mixed with any of these foreign materials is refused collection or the can is taken up and no service given. Numerous losses can be traced to such foreign matter, particularly such finer particles as readily become embedded in edible materials. Two objects which find their way into the garbage can in considerable quantities are the very thin glass from electric light bulbs and phonograph needles.

Garbage not Sorted

There is no sorting of garbage done on our farm. All hogs get an opportunity to get some of the garbage from eating places. Hogs make the most rapid gains on garbage coming from eating places as they have the greatest variety of refuse food.

In the winter, all the cans are placed in the boiler room where the cans are allowed to thaw out before the garbage is placed upon the feeding platforms or upon the ground. Frozen garbage is unsafe to feed.

At the farm, we have always fed raw garbage in preference to cooked garbage. In the first place, a sterilizing apparatus could be installed only at considerable expense; secondly, cooking destroys a greater part of the food value of garbage. Sterilization of garbage destroys the opportunity for selection. Hogs will balance their own ration much better than man is able to do. Cooking also incorporates objectionable matter with the edible garbage.

It is not necessary to supplement the feed of garbage with grain. It would not be economical nor would there be any particular advantage gained in the quality of the pork or the price paid. Feeding small numbers in separate pens is preferable. This prevents piling up in the winter time. There is no attempt to feed any particular breed of hog. There have been most losses among white hogs and the least among red ones. Raising pigs for feeding upon garbage should be entirely divorced from that part of the farm devoted to feeding of garbage.

Hogs should weigh at least 100 pounds before they are placed exclusively upon the feed of garbage. Most of the feeders are bought in the larger stockyards where a better selection can be made.

Some Discouraging Features of Feeding

The feeding of garbage has its discouraging features as well as those of an advantageous nature.

Hog cholera used to be the cause of great losses among hogs feeding on garbage, but this can easily be prevented by the serum-simultaneous method of vaccination. No hogs are placed upon the farm until they have been treated with serum and virus.

The greatest losses have been due to hemorrhagic septicemia, a form of contagious pneumonia which is usually brought into the herd through the introduction of new stock from stockyards which always are infected premises. This disease can be prevented to some extent by the use of bacterins.

Other losses occur from salt poisoning, vegetable poisoning, ptomaine poisoning and mineral poisoning. Some of the losses are due to the carelessness of the householder.

Unfavorable sanitary conditions have been the cause of losses, that is, the deep mud and filth which hogs have to wade during the rainy season or in the breaking up of the ground in the spring when the frost leaves the earth in a muddy condition, cause the hogs to become more susceptible to disease, especially respiratory troubles.

Sandy soil which allows the escape of the water and keeps the feeding ground free from mud is the most desirable for feeding conditions. Hogs fed on sandy soil made such gains during the past few months that they were ready for the

market about one month sooner than those fed upon the clay soil or upon the feeding platforms.

Summary

In summarizing, the following comparisons of garbage-fed hogs with those fed grains may be made:

1. Garbage-fed hogs show a slightly greater shrinkage in long shipments than grain-fed.
2. Garbage-fed hogs dress away very little more than grain-fed.
3. With proper management, the meat produced is equal, and cannot be distinguished from that of grain-fed hogs.
4. Garbage-fed hogs are exposed to cholera constantly so immunization is indispensable.
5. Cholera in garbage-fed hogs may be associated with secondary infections but can be controlled by immunization.
6. Garbage-fed hogs are not peculiarly susceptible to trichinosis and tuberculosis.

The secret of success with garbage-fed hogs is, as with grain-fed hogs, largely one of management. The man behind the hogs is a prime consideration. It requires hard work, no little knowledge of hogs, and a large amount of common sense to raise garbage-fed hogs. Cities undertaking municipal hog-raising and feeding must remember that the pigs are to be fed on garbage; *not on politics.*

The foregoing paper was presented before the League of Michigan Municipalities on June 26, 1919.

The Future of the American Association of Engineers

Abstract of Presidential Address by F. H. Newell at Annual Convention

"Without vision the people perish,"—without a clear view of our paths of progress toward a definite end we wander aside to attractive fields, and do not reach our object. We must have the vision of achievement; without being visionary we must have the clear view to direct all our efforts to a definite end. What is it that we see in the distant future and what is the road we are called upon to travel?

In the far distance we see a great organization with members in every county and town in the United States: A hundred thousand prehaps—as stated by some of our members, who claim that there are this number of engineers, mainly young, vigorous men, and some of mature years—who have not become identified with other engineering societies.

With a great number of widely distributed members working together sympathetically, though perhaps in different ways—there will be brought about the realization of many of our dreams of a better society and fairer economic conditions for the educated, experienced technician and professional man, whom we know as the engineer.

More than this we can see larger results to the public in better health, comfort and prosperity such as are made possible by the fact that the engineers are enabled to use their skill more effectively for the public good.

While we may solace ourselves with occasional glimpses of this distant vision we must give most of our present thoughts to the character of the road we are traversing, to its difficulties and to its diversions, not shutting from our consciousness the need of careful preparation and of effective action in overcoming the obstacles which loom in front of us. In order to gage our ability to meet these obstacles we may well look back over the road we have passed and verify our position by back sight, then project forward the results of our observations. For this reason it is desirable to briefly take our bearings on what has happened and thus more definitely fix the future path.

Taking a Backsight

The A. A. E. has completed its fourth year, it has safely passed the dangers of childhood and has already assumed certain characteristics foreshadowing a somewhat definitely fixed future development. It now seems hardly worth while to ask why it was started, but, for the purpose of the more definite backsight we may properly call attention to what is now almost ancient history.

The A. A. E. owes its birth to practically nation wide dissatisfaction with conditions as they began to appear less than a decade ago. From about 1910 there was a general increasing restlessness among the members of Engineering Societies accompanied by a tendency to criticise, but no well defined course of action. There was a call for better co-operation among existing societies and for larger recognition of the needs of the younger members. Many efforts were made to work reforms within the established organizations.

It was not then generally recognized that the plans of all the existing engineering societies were patterned upon a single model, and that one not adapted to fully cover the needs of its members. This model was regarded as the only practicable form of organization. The ingenuity of the engineer, so marked in other lines, was here in his own social affairs conspicuously absent. Prolific in inventions in other lines he was extraordinarily short sighted in the contents and form of his associations.

The real reason for this deep but vague unrest as now fully recognized—is economic. It is the fact, often denied, that the engineers of the present day as a body are wage earners. Their societies were formed originally to meet the needs of the then dominant group of independent practitioners or non-wage earners. Today these men while largely in control form a small minority. The great bulk of annual dues comes from real wage earners, who demand something more from their societies than technical papers, such as they have been receiving.

Though the need was known to be great yet the very proposal to form a new organization to meet the need, differing radically from the old, was regarded as presumptuous, as an attack upon honored conventions—almost as sacrilege. The word "bolshevik" was not then known among English speaking people but the projectors of the new scheme were denounced in the nearest equivalent terms. The lightest charge laid to their doors was that of "forming a labor union." It was assumed that any engineer who would condescend to have anything to do with an aasociation which could be compared to a labor union must have sunk to low levels.

By force of imitation—though designed for different ends, the organization of the A. A. E. in its original form tended to follow quite closely that of older societies. There was a radical indifference, a characteristic which is becoming more accentuated—namely the recognition that it was formed primarily to promote the social or human interests of the engineer as distinct from the technical. The A. A. E. has set for its first duty that of the development of the economic and political welfare of its members.

The fact that it is meeting a real need is best shown by the remarkable growth under conditions where though surrounded by older and more experienced competitors, it has outstripped them in rate of progress.

The conditions which have existed were well expressed by the retiring address of George H. Pegram from the presidency of the American Society of Civil Engineers in January, 1918. He stated that this society had joined in the formation of the Engineering Council designed to reach the 30,000 engineers in the four national societies. He adds: "But other steps are necessary. It would seem that an organization should be formed devoted to the material interests of the younger men, draftsmen, instrument men, inspectors, etc., with such association with the older engineers that their development and progress may be encouraged; in brief, an alliance of all engineering interests which would he in harmony with similar organizations in nearly all lines of endeavor."

How Do We Differ?

Our vision or evidence of things hoped for may perhaps be clarified by comparing this nascent giant with the older national societies. Primarily, as just stated, these are technical, and as such are concerned more with the strength and uses of stone and steel than with more immediate human affairs. Their main expenditures and chief pride are in high grade technical publications. These have been of inestimable value, especially in the days before the development of the great technical publishing houses. In comparison, the A. A. E. spends its funds not for technical articles but for purposes immediately concerned with the individual welfare of its members, notably in lines of employment and in other industrial relations.

The older societies have in their New York offices, spacious assembly and committee rooms with luxurious furniture, and the evidence of wealth; they have a magnificent library, rivaling that of the city of New York, across the street. All of this, laudable in itself, requires an expenditure and overhead cost which forms a serious burden and possibly detracts from the services which might otherwise be rendered.

The A. A. E. has no intention of acquiring such offices but conducts its business affairs on strictly business principles renting only such quarters as are absolutely necessary and thus making available for the service of its members a larger return on their annual investment.

Most of the older national societies are distinctly New York in viewpoint, while their officers resent the inference contained in the designation of "New York Society" yet they have not only a large proportion of their members in New York but are distinctly Eastern in attitude, while in contrast, the A. A. E. partakes more of the character of its principal center, namely, Chicago, in that it is nearer the center of population, of industry and American needs. It has some of the western initiative and the breeziness frowned upon by our Eastern cousins. It is characteristically a young man's society, initiated, operated and controlled by young men, not by any one faction, though maintaining certain group characteristics.

But comparisons are apt to be invidious and give offense where none is intended; suffice it to say that the A. A. E. has shown itself aggressive, even militant in seeking to advance the interest of its members, and to maintain the consciousness of common needs and aims.

Our Station

After taking the backsight where do we find ourselves? What does the engineer need, what is it that is attracting great numbers into the A. A. E. and which is not being found in the other societies?

First, and foremost, is the need of adequate compensation.

Second, is the need involved in the phrase "self expression."

"But," say many of our good friends, "if you begin to talk about wages and conditions of employment you are forming a labor union." "We in the past have carefully avoided anything which might point toward commercialism or tend to lower our professional standards; moreover we believe that the younger men should be satisfied; they are getting as much as we did at their age."

The whole matter of wages, according to orthodox opinion, has been regarded as one too explosive to be handled by a technical society. It is a shock to some of our older associates to have pointed out the fact that other professions in so doing have, in England at least, not lost their dignity nor standing in public esteem. As pointed out in Engineering-News Record of April 10, 1919, "All the devices by which the trade unions attain their ends have been practiced by professional association. As soon as professionals began to be employed at salaries they took to collective bargaining and insisted upon a standard minimum remuneration, refusing to accept employment, resorting to the boycott and even the strike. This is particularly true of the teachers and doctors, and in one or two cases their associations have been registered as trade unions. Professional associations have practiced militant action by resorting to political pressure, and this has become an important feature of the modern association."

Wages

A review of present conditions of employment of the great mass of men designated as engineers, who make up the assumed hundred thousand non-members or non-active members of engineering societies, shows that many of them are underpaid, notably those who are in the employ of railroad companies. There the effective action of the A. A. E. and its colleagues is already producing results. A still greater number are in public employ, in federal, state, county and city work. They are occupying positions of responsibility, but the public is usually ignorant of the fact that it is dependent upon their judgment and skill for the safe conduct of its daily affairs, of transportation, of lighting, of heating, of water supply, of sewage and innumerable other details. The cry has come up again and again from such underpaid men for some consideration but in return they have been "given a stone" in the form of a report showing the large earnings of the members of the A. S. C. E., for a time stopping efforts in this direction.

Why Underpaid?

The answer is perfectly obvious. It is because by education and by tradition the engineers have been cautioned against things which savour of commercialism, they have not been taught that under modern conditions no body of men can be assured of equitable treatment unless it takes measures toward group self-protection, unless it organizes to present the claims of its members to the public and takes effective steps such as those followed by the older professions of law and medicine.

Without organization and without a broad outlook which comes from such action, scattered individuals have not been able to get a wide enough viewpoint properly to appreciate their own conditions. They have felt that something is wrong and have been correspondingly restless, whether in or out of the other societies. Moreover they have not fully appreciated the fact that money values have changed, that gold has depreciated and that while all living expenses have advanced, yet those wages which have been set by custom and sometimes by law have been left untouched for a half century.

Many curious things have been revealed by the studies recently entered upon by the A. A. E., showing that railroads and municipal officers set what was in old times a liberal salary or wage but since the days of our own Civil War have persistently refused to modify these. Even now the wages of engineers or surveyors in some localities are fixed at $2.50 or $3 a day or at amounts less than those demanded by a carpenter or mason. Through all these years and in spite of the pressure brought to bear to study and report upon these conditions the engineers as a body pursuing their dignified course, have looked beyond these immediate needs and have passed by safely on the other side.

Results of Underpayment

But what are the results of these conditions of underpayment? They have been obvious in the mental attitude as well as in physical condition of the engineers themselves and have been reflected in a lowered or indifferent public opinion. While the true compensation of an engineer must not be expressed wholly in terms of money and while he receives many things which cannot be given a cash value, yet there exists the condition that the public at large and public officials necessarily judge and grade a man according to the compensation he receives. This is an inexorable law, although a man may possess the highest engineering and executive ability and yet if he does not receive a commensurate salary he finds himself handicapped at every turn, not merely for lack of the ready money but because he is deprived of his corresponding status in the eyes of those about him. He cannot take the leading part to

which his abiiities entitle him and where he can be of corresponding value to the public.

Do not mistake me, however, I do not wish to imply that because a man is poorly paid that this is proof that he is deserving of larger wages. This no more follows than does the inference that because a man is poor therefore he must be honest. What I am trying to emphasize is the fact that it should be our business to see to it that every possible effort is made on behalf of wage earning engineers that they do receive a compensation in money or in other values commensurate with their just deserts, at the same time being absolutely certain that they are really "delivering the goods." Because a man insists that he is underpaid there is no necessary conclusion that he is doing more than that for which he is paid. It is up to him to prove that he is "100 per cent efficient and then some!"

Self-expression

But what beyond wages does the engineer need; what is it that he has been demanding? It is the opportunity for more complete expression, for doing those things which are demanded of him by modern conditions but from which he is withheld by lack of facilities, particularly by lack of organization effective in its dealings with civic duties.

In reply to this it is vigorously asserted that some societies have afforded such opportunities. Here is where there is a distinct difference of opinion:—those of us who have worked for a generation under the written and unwritten laws which have prevailed among older engineering associations have slowly come to see that these have recognized only a narrow range of activities; we have been restrained unconsciously by the assumption that there is only one standard and that any departure from this is anathema. With especial care safeguards have been erected against any activity which looks toward the civic or political duties of the engineer. Of late it is true that these have been relaxed somewhat but long years of intimate association leads to the thought that should the competition of the A. A. E. be relaxed, there would be a tightening of the limits.

Repeating again the fact that these comparisons are not intended to be invidious, it is here asserted that to bring about a real self-expression of the great mass of wage earning engineers there must be a broad movement along entirely new and modern lines of thought, as typified in the A. A. E., not hampered by traditions but following a free form to be developed by experience.

What Are We Doing?

First, service to our members when they need service, and through them service to the public. Service to the members is that of getting together men of common interest such as arise from common surroundings, education and experience and which causes them to have a common viewpoint. By mere association and by numbers each gains strength to render service to others and especially through better conditions of employment, made possible by united action, by publicity, by discussions, and by effective mingling in public affairs.

We can do those things for each other and for engineers in general which singly they cannot effect.

Already by its aggressive methods the A. A. E. has forced tardy recognition of the claims of many of the underpaid, for example, it was not until the officers of the A. A. E. had appeared before the Railroad Wage Board with digested data that there was hope of relief.

These statements, mind you, are made simply as recitals of fact to illustrate the point that it has been only through generously offered aid that former leaders, held by conservatism, have been willing to depart from their narrowly defined grooves of activity. There is every reason to suppose that, should the A. A. E. stop tomorrow, these other groups would drop back to their former placid course.

But even if the A. A. E. should stop it would have justified all of its expense and efforts in stimulating larger activities and recognition of the possibilities of such activities among engineers as a whole.

Quantity

Our effort from now on should be for quantity; in numbers is strength, and with strength the ability to accomplish our aims. In saying this we do not ignore quality; we assume at all times that engineers must be men of good character and of high ideals. It is by bringing such men together, by gaining strength and self-confidence of the mass, that many of the better qualities of the individual may be developed.

The objects we strive to obtain, those of higher social and economic conditions among engineers, that they may more largely benefit humanity, can be had only through large numbers of citizens acting in unison. The leaven of high ideals of service represented by the founders of the association, to be effective, must have the mass on which to act; it is this massing of men which results in ultimate effectiveness.

Generous Competition

We are willing to compete for membership in a fair and open field. The greatest stimulus to efficient and economical conduct of engineering affairs, as in the case of all similar human enterprise, comes through magnanimous competition, through playing the game squarely and letting the best man win on his merits.

It is true that there is danger of competition degenerating to strife, or that in the exuberance of young spirits there may be things said and done which are to be regretted. This is one of the inevitable but not irremediable conditions which are to be plainly faced. It is far better to run the risk than to abstain from good achievement through fear of giving offense.

Some of our acquaintances regard the entrance of the A. A. E. in their locality as an intrusion upon their private preserves. They say in effect, "We have already started a local branch of a national society or a local club, and you have no business coming into our town seeking members among the group who should come to us." Here is a question worthy of consideration. Its answer rests upon the assumption as to whether priority gives exclusive rights. The question is similar to that in other enterprises where one business has been established and another seeks an opening alongside or across the street. The man who has had a monopoly naturally feels that his rights are being infringed upon.

When we come to specific statement of these matters it is usually found that the existing organizations have been founded upon a radically different concept. They have been following along a rather narrow line, giving primary consideration to material or technical details as contrasted with the human, namely, the economic and social welfare, which is the main object of the A. A. E. The more definitely these distinctions are pointed out, the more obvious it is that instead of being of the nature of an intrusion, the entrance of the A. A. E. into local fields has a stimulating effect.

Missionary Efforts

We are distinctly a missionary organization, sending out our members, literally as well as figuratively, into the highways and byways, to bring in all men of good character who are properly classified as engineers, and who, because of their characteristically retiring attitude, have held aloof or have been unconsciously isolated from contact with their fellows. There are in nearly every community two, three or a half dozen or more engineers, each living something of a hermit life as regards his social or professional relations, unaware often that other men of similar education and tastes are within easy reach. It is our aim to get such men to know each other and to gain strength for good in the community by association.

While each by himself may have a certain influence, the two or three acting together will have several times as much strength, and so on in an increasing geometrical ratio.

Education

This is an educational movement, not only of the members, but of the public. The mere act of bringing together men of similar experience and tastes is in itself an education to them not only in mechanical lines, in "shop talk," but, more than this, in the practice of active citizenship.

We strive to stimulate study of the live topics of local, state and national importance and try to maintain an intelligent interest in the big things around us, those which grow out of large applications of engineering data. While we do not ignore the small matters of technical details, yet our daily thought should be on the big things which influence our own lives and of those about us. Our activities and our publications should be devoted to those matters which affect the largest number as contrasted with the technical affairs, important in themselves, but which concern only a few. These are being well handled by other organizations.

Principal among our educational features should be those of the duties of citizenship. These are larger in the case of the engineer than of any other one class of citizens, for the destructive activities of war as well as the constructive work of peace are creatures of his brain. He has been content in these to take the subordinate part, but with corresponding loss of efficiency to humanity. The fear of doing something outside the narrow limits of his profession has deterred him from spontaneously assuming his full share in civic affairs.

This educational movement on the part of the A. A. E. performed by it or forced upon the attention of its competitors should be the greatest movement in the history of engineering. We may well claim the credit of taking and maintaining the lead, for it is an open secret that had not this young society come into the field there would have been little backing for progress along these essential lines.

Our duty is to be militant in missionary and educational lines—even aggressive in the same sense as the "church militant" of modern times, ready to champion the cause of the individual engineer wherever we have evidence to show that he or his associates are suffering under oppressive conditions—turning on the sunlight of publicity and taking such action as may be possible.

Foresight

Having taken our backsight and viewed our surroundings, it is now possible for us to take the foresight for the year ahead. Our immediate object, as just stated, is quantity of members. We should include every engineer of good character who has the community of interest and of thought which arises from the common education and experience, bringing together those of similar habits of thought, and who, though isolated in the past, can work together effectively.

We should strive not merely for the advantage of these members, but for the good of the whole profession and of the public. This must be done immediately through taking up the questions of employment, of better conditions for service, extending aid not only to the great body of engineers in the employ of the railroads, but to the even larger number of men in public service, concentrating if necessary for a time on these great groups. Through service to them we can most effectively serve all.

We should co-operate with our neighbors in other organizations doing our part, for example, in aiding in the formation of a Department of Public Works. This, though a large question is in itself not as important to our members as is the question of better conditions of employment in any department of public works whether national, state or municipal.

Our slogan for the present may be "engineering for engineers." We must do all that we can to prevent the continuance of conditions such as those where the great public engineering operations are directed primarily by politicians, lawyers or business men who as executive superiors attempt to dictate to the engineer what he should do. Let us specifically demand that the next Secretary of the Interior shall be an engineer, and that in every Department of Public Works—state or city—the chief shall be a qualified engineer. Nor should we be discouraged if at first our efforts meet with little success. We must remember that by long acquiescence in the appointment of other than engineers to leading engineering positions we have permitted the public to have a wrong conception of engineers, one which can be removed only after protracted effort.

Nor should we be disappointed if in gaining numbers of engineers we find that many remain as members for only a short time. This condition is inseparable from an organization with our aims and ambitions. Many will join in the hope of immediate personal benefit and when this is gained they will depart. The membership should be free to thus come and go—its steady growth testifying, however, to the fact that as a whole the great body of engineers are content and are taking an altruistic interest in larger affairs.

All great popular movements of this kind must necessarily change with the shifting of human interest and our organization must be elastic while remaining effective.

One principle should be fixed, viz., that we should strive to aid each member in building himself up in his own community and co-operate with him in helping others in his vicinity, thus strengthening all. To do this, the broadest possible local autonomy should be provided so that each small group may take advantage of those conditions which are peculiar to its environment and which lead to ultimate success. Each member should feel a sense of proprietorship in the association as a whole and consequent responsibility for the success of all.

With these thoughts in mind—with the vision of large possible achievement—let us press forward enthusiastically and energetically, gathering to ourselves more and more members not merely for the sake of numbers but because with numbers we may achieve the high ideals set for us in raising the standards of living and of ethics and through these widening our opportunities for service and our influence for the material and spiritual welfare of the nation.

Summary of a Forthcoming Federal Report Entitled, "Economics of the Construction Industry"

The following summary of a forthcoming report entitled, "Economics of the Construction Industry," has been prepared by the Division of Public Works and Construction Development, Information and Education Service, Department of Labor, Franklin T. Miller, director:

In January, 1919, the Division of Public Works and Construction Development was organized as a branch of the Information and Education Service of the Department of Labor. Its purpose was to be the stimulation of the interest of the Nation in public and private construction with a view to the creation of buffer employment for labor during the period of transition of manufacturing industries from war to peace production. It was charged with the securing of data for the use of the construction industry, but its activities were also to comprehend a study of the economic conditions affecting industry as a whole.

In conformity with its purpose it has given wide publicity to the material which it has gathered on prices and price tendencies in the construction industry, and to such other information as it believed was of immediate value for the construction industry and for general industry. Its findings are contained in "Economics of the Construction Industry," now in press. In the following paragraphs a brief summary of these findings is presented, which it is hoped will provide conviction for those who, on the threshold of an era of business prosperity, still hesitate. On the basis of its study it has come to the conclusion that construction in 1919 can be justified on finan-

cial grounds. It rejoices to find such a widespread acceptance of its views as is evidenced by the remarkable resumption of construction activity of the last three months. It looks to public officials and private and speculative builders everywhere to maintain or increase the present activity, for it feels that by so doing they will not only be securing a reasonable return on their investments, but that they will also be relieving the unprecedented shortage in housing, supplying needed employment, and allaying much of the industrial unrest incident to a period of readjustment.

The New Commodity Price Level

1. Most people believed that the high level of prices reached during the war was caused merely by the extraordinary demand for commodities, which exceeded the supply. With the end of the war and with war demand a thing of the past, they quite naturally expected a sharp drop in prices and a price level approximating in a short time the pre-war price level.

2. It was also commonly believed that the industrial capacity of the world had been greatly expanded under the stimulation of war orders, and that this expansion would bring sharp competition between rival concerns in time of peace. Furthermore, it was thought that there would be after the war great armies of unemployed workmen, who would be compelled by necessity to accept work at low wages; that there would be sharp competition among the leading nations in international trade; and that buyers generally, looking forward toward an era of lower prices, would postpone buying. In the light of these considerations it was but natural for people to expect a great fall in prices, and even to fear an industrial panic.

However, the expected great fall in prices has not occurred, and it is not likely to occur for the following reasons:

3. The rise in prices during the war was not merely the result of a great demand for goods and of a scarcity of certain goods. It was largely brought about by means of inflation of the currency by the governments at war and by the neutrals, either by the direct issue of paper money or by the issue of bonds. Although war orders are now largely a thing of the past, the extension of credits still exists as a continuing cause of high prices. There is little to indicate an early contraction of credits.

4. World production in general during the war, contrary to a widely held view, was not abnormally large. This is shown by statistics of world production of leading basic materials of industry, such as coal, petroleum, iron ore, and of cotton, sugar, wool, wheat and other agricultural products. Consequently the abnormal consumption of goods for war purposes has depleted the stocks of commodities of the world.

5. Armies of unemployed, in the United States at least, have not materialized, and an actual labor shortage is in prospect. Wages are not likely to be lowered.

6. Buyers since the armistice, although showing a desire to wait for lower prices, have been compelled to buy to meet their daily needs. During the war, because of scarcity of commodities and high prices or because of patriotic self-denial, they did not buy in advance of need, as is customary in an era of rising prices. Consumers' goods are in great demand and retail trade is now moving in great volume.

7. If the production capacity of industry should be greatly increased, lower prices would not necessarily follow. If there is a strong enough demand for commodities, prices need not fall, no matter in how large volume commodities are produced. There is every reason for expecting such a strong demand. The world is now suffering from a great shortage of durable goods—buildings, transportation facilities and industrial equipment. Furthermore, people, both in the United States and Europe, have a stronger desire for consumers' goods than ever before. This is true partly because of the scarcity of certain goods during the war period, and partly because of the new experiences through which tens of millions have passed, which have awakened in them desires for goods and services they never enjoyed before. Along with greater production of goods there is likely to go further extensions of credits rather than contraction. Neither the credit system of the United States nor that of the world has reached the limits of its power of expansion.

8. Business men of the United States need not hesitate to plan for an immediate period of business prosperity. No period of depression and no collapse of values need to be feared. The man who goes full speed ahead will gain an advantage over his procrastinating competitor which will far outweigh any possible slight decline in costs of production.

For a fuller discussion of the effect of inflation on prices see "The New Price Revolution," by Prof. Irving Fisher, Yale University. Prof. Fisher's paper is briefly summarized in the following paragraphs:

9. Prices are not going to fall much, if at all. We are on a permanently higher price level, and business men should go ahead on that basis.

10. The general level of prices is dependent upon the volume and rapidity of turnover of the circulating medium in relation to the business to be transacted thereby. If the number of dollars circulated by cash or by check doubles, while the number of goods and services exchanged thereby remains constant, prices will about double.

11. The great price changes in history have come about in just this way. The price revolution of the sixteenth century was a result of the great influx of gold and silver from American mines. A similar increase in prices all over the world occurred between 1896 and 1914, following the discovery of rich new gold fields and the introduction of cheaper methods of mining.

12. The present rise in prices has resulted from the great extension of credits by the countries at war, and a more economical use of gold reserves as a basis of credit, and not from any great increase in the gold supply of the world. In the United States, however, the supply of gold has been greatly increased because of our large excess of exports of commodities, and our present gold reserves would permit of a much greater expansion of credits than exists now.

13. There is a little likelihood of a fall in prices in the United States. The gold reserve, which is now the basis of our currency, is not likely to leave the banks and return to general circulation, since this is contrary to monetary experience. No great outflow of gold is to be expected through international trade, since our exports are likely to exceed our imports in the reconstruction period, and we no longer will have large interests and freight payments to make to Europe. Prices are higher in Europe than in the United States, and hence no influx of cheap goods is to be expected. Further issues of bonds or treasury certificates by our Government and loans placed by European countries in this country will tend to further increase our present credit structure. Against any considerable reduction in bank credit the whole business community would rise in arms.

Cost and Supply of Building Materials

14. Government restrictions and decreased demand reduced the production of most building materials in 1918. This reduction necessitated the operation of plants below their normal capacity and increased the proportion that fixed charges bear to total costs.

15. Curtailed production during the war resulted in low stocks of many building materials at the signing of the armistice.

16. As a result of the increase in the cost of living and of competition with essential war industries for labor, the wages of workmen in the building materials industries were raised. In some industries, largely because of abnormal labor turnover, the efficiency of labor was reduced and labor costs mounted out of proportion to other costs.

17. Costs of raw materials, transportation, fuel, taxes, sales and other items that make up total costs have all increased.

18. The increased cost of building materials as a whole must generally be considered in the light of curtailed production, low stocks, increased costs of labor, transportation, fuel and plant maintenance.

19. Past experience has shown that prices of building materials fluctuate less rapidly than the prices of raw materials used in manufacturing industries, such as metal ores, hides, etc., and than the prices of commodities that are consumed from day to day, such as food and textiles. Building materials are not likely to respond rapidly to any but a marked reduction in the general price level.

20. A marked reduction in the price of building materials is dependent upon the reduction of the items mentioned under 18. It is not to be expected that wages, the largest single item in costs, will be reduced in advance of a reduction of the cost of living. In view of the mounting operating expenses of the railroads it is not likely that transportation charges, a very large element in the cost of building materials, will be lowered. With the maintenance of the general price level the price of building materials as a whole can not well fall.

21. The index number for lumber and building materials (not including metal products) was in April, 1919, 184; for building materials, including iron and steel production, 189; for commodities other than building materials, 211; for all commodities, 203; for farm products, 228 (100=July 1, 1913—June 30, 1914).

22. Building materials are relatively low in price.

New Low Level Record Reached in Trinidad Asphalt Lake Soundings

Recent borings made in the famous asphalt lake on the Island of Trinidad have reached a new low level record of 150 ft. The previous record, made in 1893, was 135 ft. On both occasions the asphalt was found to be of uniform character throughout.

These latest attempts to find the bottom of the great mass of asphalt were conducted by George A. Macready, geologist, at the instance of Dr. Clifford Richardson, who has studied this asphalt wonder for many years.

Great difficulties attend any attempt to sound the lake, as it is in constant, though almost imperceptible, motion. The pressure of the mass of asphalt at any great depth against the drilling apparatus causes it to bend and the deflection from the perpendicular is so great that further boring is prohibited.

In the borings which have just been made a core of asphalt was taken by driving a small pipe into the pitch and then withdrawing it with its contained core of pitch. Following this, a pipe of 2 ins. diameter was driven to the lowest depth to which the core was taken and the material forced into it by driving was removed by means of a water jet and bit. Another core was taken below the 2-in. pipe in the untouched pipe. The deepest of these borings was taken at the center of the pitch lake and the asphalt was found to be of uniform character throughout. After completion, this hole was observed to have shifted at the surface 25 ft. in six weeks; a survey showed the movement to exist as deep as 100 ft., and there was a suggestion that the direction was reversed at a depth of between 25 and 50 ft. The other borings, not at the center of the lake, shifted to a lesser extent. The movement of the asphalt seems to be similar in many respects to the ascending and descending currents in a kettle of boiling water.

The problem presented is difficult of solution, as it seems to be impossible to find any material which will withstand the bending strain imposed upon it by the pressure of the mass of semi-solid asphalt.

The Austin Mixer Loader

The Austin mixer loader, which eliminates shovelers, is adapted for use either with end or side loading paving mixers.

The loader, by means of the power shoveling and measuring machines, requires only three men for its operation and will load and deliver more material in accurately measured batches than can be run through the mixer at capacity. In this manner the drawback of the past, where the mixer was delayed in its action, due to shovelers, is eliminated so as to reverse the action.

The fact that the Austin automatic loader can be used for loading wagons, etc., when not in use as a loader for mixing purposes, makes it valuable to the paving contractor who continually is requiring a loader in connection with his work.

The action of the loader is as follows: A continuous running belt conveyor is arranged to feed the concrete mixer loading skip or hopper. This continuous running belt conveyor is operated with a hopper cooled gasoline engine and equipped with traction, friction clutch controlled.

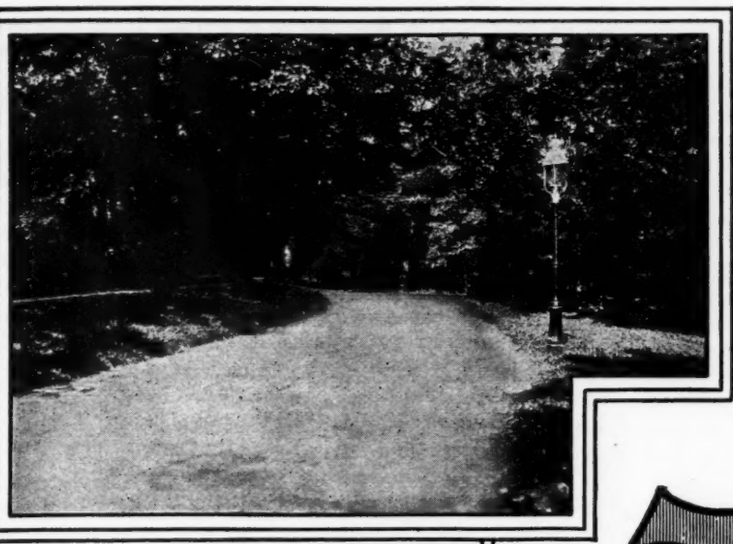
The material is arranged in wind-rows either side of the belt conveyor on the road to be paved and the automatic oscillating shovels are arranged on either side of the belt conveyor and in front of the material wind-rows.

The oscillating shovels work back and forth through the material piles arranged automatically according to their widths with the self-feeding loader for the buckets. This loading device consists of two eccentrically mounted discs that continually sweep through the material with a range of 5 ft., 6 in. Mounted over these discs are a series of curved feeding blades that carry the material from the pile to the bucket path automatically withdrawing from the load so that the buckets have a clear sweep across the discs for loading. The shovel rapidly eats away the material pile and advances forward continually. The measuring hopper is fed from the shovel by means of a belt taking the load of the buckets and one man located between the two shovels trips the measuring hopper doors and allows the measured material to be discharged onto the continuously running conveyor which carries it into the mixer loading hopper or skip. The Austin mixer loader is manufactured and marketed by the F. C. Austin Co., Inc., Chicago, Ill.

City Planning in Bethlehem, Pa.

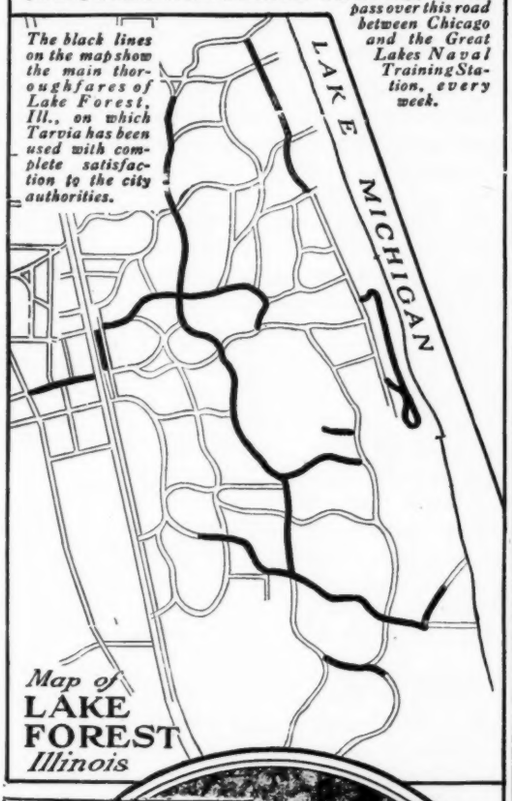
The City of Bethlehem, Pa., which was incorporated July 17, 1917, is now making great progress in city improvement. Some 7 months ago the City Planning Commission of Bethlehem retained Frank Koester, Consulting Engineer and City Planning Expert, 50 Church St., New York City, to make a study of the city and surrounding territory prior to preparing a report of a comprehensive city plan. The many civic improvements made in the neighboring City of Allentown within the past few years are the results of Mr. Koester's city planning report for Allentown, made in 1915 and this lead to his engagement by the City of Bethlehem.

Mr. Koester's report has recently been accepted by the City Planning Commission of Bthlehem. It covers, among other features, Interurban Arterial Highways, City Streets, Sidewalk improvements, Bridges and Bridge Approaches, Street Railways, Parks and Play Grounds, Proposed Great Ground Plan, Homes for Industrial Workers, Promoting New Industries, Civic and Educational Centers, and City Sanitation. Special attention is paid to a most extensive park and play ground system, and the City of Bethlehem has, in the meantime, acquired large tracts of land for this purpose.



A section of Sheridan Road, Lake Forest, Ill.. 18,000 square yards of which have been Tarviated. Thousands of vehicles pass over this road between Chicago and the Great Lakes Naval Training Station, every week.

A driveway on the Lake Forest, Ill., estate of Mrs. C. H. McCormick. "Tarvia-X" two-course penetration and surfaced with "Tarvia-A."



The black lines on the map show the main thoroughfares of Lake Forest, Ill., on which Tarvia has been used with complete satisfaction to the city authorities.

Map of LAKE FOREST *Illinois*

Entrance to the private estate of John T. Pirie, of Carson-Pirie-Scott Co., Chicago, Ill., at Lake Forest, Ill. Waterbound macadam treated with "Tarvia-A."

Tarvia

Preserves Roads Prevents Dust—

An ideal road material for private estates and public roads—

THE photographs on this page show three Tarvia drives in beautiful Lake Forest, Illinois.

The black lines on the map show the extent to which Lake Forest has adopted Tarvia for its main thoroughfares.

Tarvia roads are ideal for beautiful suburban sections. Their firm, smooth surface "sets off" perfectly the lawns of beautiful green turf, with their borders of shrubbery and their canopies of lordly trees.

And besides adding materially to the attractive appearance of a section, Tarvia roads add to its "liveability," because they are clean and mudless and dustless.

Whether for the heavy motor truck traffic on main highways or for private driveways such as are here pictured, Tarvia roads are, above all, *a good investment.* They help to keep down taxes because they are low in first cost, and, being waterproof, frost-proof, and automobile-proof, they require little outlay for maintenance.

That is why the mileage of Tarvia roads grows by leaps and bounds every year. Tarvia today is the most popular road-making material in America.

Special Service Department

This company has a corps of trained engineers and chemists who have given years of study to modern road problems. The advice of these men may be had for the asking by any one interested. If you will write to the nearest office regarding road problems and conditions in your vicinity, the matter will have prompt attention.

Write for illustrated booklet and further information

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Personal Items

Lieut. Colonel George A. Johnson and Major Webster L. Benham have formed a partnership for a general consulting engineering practice under the firm name of Johnson & Benham. Offices at 150 Nassau St., New York City, and Firestone Building, Kansas City, Mo. Colonel Johnson is still in the service but anticipates discharge during the coming autumn. He was originally officer in charge of the water and sewer section of the M. & R. Branch of the Construction Division of the Army. Later he succeeded to the position he now occupies as second in command of this branch which has sole jurisdiction over the water supply, sewerage and sewage disposal, electric light and power, ice and refrigeration, heating, highways, railroads, buildings, fire departments and systems in several hundred military establishments in the United States and dependencies. Prior to Colonel Johnson's entrance into the service he was engaged in a Consulting Engineering practice at 150 Nassau St., New York City. Major Benham was discharged from the service on May 1st, 1919, having served with the Construction Division of the Army since October, 1917, as officer in charge of utilities and Construction Quartermaster at Camp Funston, Kansas. Later he was appointed regional supervising utilities officer for the camps in the southwest, in addition to his other duties, and on March 24th, 1919, he was ordered to Washington as assistant to the chief of the construction division. Prior to his entrance into the service he was president and chief engineer of the Benham Engineering Company, Consulting Engineers, Oklahoma, City, Okla. The new firm will handle the various phases of design, estimates and supervision of construction, operation and maintenance in connection with problems of water supply and purification; sewerage and sewage disposal; investigations of epidemics; electric light, heat, power and refrigeration systems; water power development; roads and pavements; reports and appraisals; and public utilities management. Until Colonel Johnson leaves the service, Major Benham will be the active head of the firm.

Trade Notes

Announcement is made by the Barber Asphalt Paving Company, Philadelphia, that following the promotion of Mr. Charles W. Bayliss, formerly manager of the street and road department, to vice president in charge of sales, the following changes in organization became effective June 1, 1919: Mr. J. E. Morris, manager street and road department, Philadelphia, Pa.; Mr. H. M. Stafford will succeed Mr. J. E. Morris as assistant manager in charge of the Eastern district, with headquarters at Philadelphia; Mr. F. F. Massey is promoted to succeed Mr. Stafford as assistant manager, in charge of the Southwestern district, with headquarters at Memphis, Tenn., and Mr. G. R. March is promoted to succeed Mr. T. H. Morris as sales manager of the Iroquois department.

Sauerman Bros., Monadnock Block, Chicago, Ill., announce the return of Major D. D. Guilfoil to his former position as sales engineer. Major Guilfoil came back from France in command of the First Battalion, 108th Regiment Engineers, on May 23, received his discharge at Camp Grant on June 7, and was back at his old job on June 9. The 108th Engineers, composed mainly of Chicago men, participated in the Somme and Meuse-Argonne offensives, and, following the armistice, was a part of the army of occupation in Luxembourg.

The Southern Asphalt Association, comprising the principal public works contractors engaged in laying asphalt pavements in the South Atlantic States, opened offices in Atlanta on June 1st, in the Healey Building of that city. The Association will be conducted in the interest of asphalt roads and pavements in the South Atlantic States. The purpose of the Association is to create a wider and better knowledge among public officials and tax-payers of the utility and advantages of asphalt for road and street purposes. This is to be accomplished by a general publicity campaign. In addition, the Association will endeavor to keep experienced and skilled workmen steadily employed by putting them in touch with the members of the Association who have need for their services. Mr. Walter Ely, president of the Ely Construction Company, Augusta, Ga., has been elected president of the association, and Mr. W. R. Mayrant, general manager of the Simmons-Mayrant Company, Charleston, S. C., has been elected vice president. The following board of directors have been elected to serve for one year and will determine the policy of the association: W. S. Ely, W. R. Mayrant, R. M. Hudson, president of R. M. Hudson Company, Atlanta, Ga., Fred L. Connor, president of Murray Construction Company, Knoxville, Tenn., and W. R. Dunn, of the Dunn Construction Company, Birmingham, Ala. Mr. J. M. Woodruff, who recently resigned the position of manager of the publicity and paving departments of the Standard Asphalt & Refining Company, a subsidiary of the Cities Service Company, has been engaged as general manager of the association and assumed his duties on June 1st.

The Tarvia Road Book, for highway engineers, contractors and road builders has been issued by the Barrett Company. This is a valuable technical handbook of real value to anyone with a practical interest in good roads. It gives quantitative data on various kinds of road and pavement materials per unit of length. It also gives Tarvia specifications. A copy will be sent free to any interested person who applies at the nearest Barret office. It measures 3½x6 ins. and contains 72 pages.

Two new bulletins have recently been issued by the T. L. Smith Co., Milwaukee, Wis. One relates to Smith Pumping machinery and the other to the Smith Paving Mixer. Each bulletin measures 7½x10¾ ins. and contains 16 pages. In the pump bulletin the Smith force, centrifugal and diaphragm pumps are illustrated and described and their special fields of usefulness enumerated. The same character of information is given for Smith gasoline and kerosene engines. Information is given on the selection, purchase and operation of pumps. There are three pages of hydraulic engineering data. The bulletin on the Smith Paving Mixer illustrates and describes every part of the mixer and points out its advantages.

The H. W. Clark Co., of Mattoon, Ill., manufacturers of water works equipment, now occupy their new factory just completed at Mattoon, Ill. Their former plant was destroyed in the tornado of May 26, 1917. Since the tornado and prior to moving into their new plant, they operated in temporary quarters and succeeded in taking care of their customers and in holding their business together. The plant comprises an engineering and drafting department, pattern shops, gray iron foundry, brass foundry, blacksmith shops, machine shop, sheet iron works, and Nickel plating plant. It is located on two spurs from the Illinois Central Railroad, being supplied with two tracks, one for incoming material, and the other for outgoing finished products. The H. W. Clark Co. has been in business for more than 25 years, and their line is well and favorably known throughout the country.

"Spring Rains and Floods" is the title of a folder calling attention to the fact that there have been several typhoid fever epidemics directly traceable to contamination of water through surface wash and the run-off of melting snow. All surface water supplies are subject to this form of pollution and should, therefore, be sterilized as the interesting folder states. It is issued by Wallace & Tiernan Co., Inc., 349 Broadway, New York City.

WATER WORKS SECTION

The Design and Operation of the Water Filtration Plant at Camp Meade, Maryland

By C. R. Potteiger, Captain, Q. M. Corps, Officer in Charge of Water Filtration and Pumping Stations, Camp Meade, Admiral, Maryland

When the site for the location of Camp Meade was selected, the question of water supply was very important. It was originally intended to use the water from driven wells for construction purposes, and it was expected from the statements made by the geological experts in the state of Maryland, and of the U. S. geological survey that water could be obtained in copious quantities from this source.

Wells Tried and Abandoned as Source of Supply

The geological authorities advised that there were three water bearing zones or sheets of water underneath this territory, one at a depth of about 100 ft. at Annapolis Junction, dipping to 170 ft. at Naval Academy Junction; another zone 200 ft. deep at Annapolis Junction and about 315 ft. deep at Naval Academy Junction, and a third zone probably as deep as 350 ft. at Annapolis Junction and from 500 to 600 fet. deep at Naval Academy Junction.

As a result of this information it was decided to drill eleven wells at various locations throughout the cantonment which were widely distributed and available for delivering water into the distribution system in the various sections in the cantonment.

Considerable trouble was experienced in getting sufficient quantities of water from these driven wells to supply the camp during the whole of the construction period and during the first few weeks of the period, when the drafted men first came to camp.

In a report by the supervising engineer to the construction quartermaster on Oct. 23rd, 1917, there was indicated in the various wells a total available quantity of water of 1,008,000 gals. per day. A total of 453,000 gals. were reported as being available through high head pumps, 173,000 gals. available through medium head pumps, 288,000 gals. available at wells not equipped with pumping machinery and 94,000 gals. per day available through installation of a larger equipment.

The wells were abandoned as a source of supply and the project adopted contemplated the pumping of water from the Little Patuxent River, with low life pumps to the filtration Little Patuxent River, with low lift pumps to the filtration camp, to a hill, at an elevation of about 300 ft. north of the cantonment site.

Supply From Little Patuxent River

The Little Patuxent River from which the water is drawn for the use of the Cantonment has a drainage area above Welch's Bridge of 126.8 square miles with an estimated population of the water shed area of about 6,900. It lies for the most part in Howard County, Md., of which it constitutes the central and southeastern portion. The extreme southeastern portion of the drainage area is situated in Anne Arundel County. The area has an extreme length from the headwaters of the Middle Patuxent River, the principle tributary of the Little Patuxent, to the intake of approximately 21½ miles. The main axis of the watershed area extends from the northwest to the southeast. The average width of the drainage basin is 5.9 miles.

The area is largely devoted to agriculture with few villages and few manufacturing plants. The different farmhouses are provided with privies and have no direct connection to this stream.

Characteristics of the Stream

The flow of the Little Patuxent River is flashy in character. The river responds promptly to rainfall upon its watershed, and falls rapidly after storms have passed. It is estimated that the river flow at Welch's Bridge is, at the extreme minimum 4.01 M. G. D.; ordinary minimum 6.01 M. G. D.; and the average daily flow calculated from daily averages for 16 years, 111.9 M. G. D.

The waters of the Little Patuxent River have an extraordinary range in turbidity, and vary in that respect with extreme rapidity. Readings of raw water turbidity are taken every two hours at the filter plant laboratory and records are available for the whole period of the year 1918. During this time the average daily turbidity ranged from a maximum of 4,000 p.p.m. to a minimum of less than 10 p.p.m., the mean value of the period having been 210 p.p.m. The maximum turbidity observed on any individual sample was 5,500 p.p.m.

The alkilinity of the raw supply is variable, reaching a maximum of perhaps 45 p.p.m. during dry periods and a minimum value of less than 5 p.p.m. during floods. At times of low turbidity it is necessary to increase the alkalinity by dosing with hydrated lime which reacts with the required doses of coagulant. The lime is added in solution and suspension directly into the suction lines of the pumps at the low lift pumping station.

Analysis of Raw Water

Analysis of the water in the Little Patuxent at Welch's Bridge as made by the Maryland State Department of Health is as follows:

	Minimum	Maximum	Average
Turbidity	10	1900	428.365
Total Solids	86	1938	511
True Color	20	64	365
Free Ammonia .	0	0.07	0.038
Total Abl "	0.05	1.28	.31
Chlorine	3.2	5.9	4.22
Nitrates	.0	.7	.27
Nitrites	....	trace	.....
Hardness	4.0	40.0	21.1
Iron	.4	30.0	5.5
Alkalinity	11.0	31.0	23.0

Bacteriological analyses show that the waters of the stream are seriously polluted. This pollution is indicated both by the large numbers of organisms developing as a total count on standard nutrient agar incubated for 24 hours at 37° C. and by the large numbers of B. coli present. The total agar count during the period of February 1918—January 1919 inclusive varied from a maximum of 86,000 per c. c. to a minimum of 40 per c. c., the average number being .332 per c. c. The number of B. coli presumtively determined have varied from probably more than 1,000 to 0 c. c., and have roughly averaged 63. The numbers of B. coli reported must be considered as rough estimates only. It may be definitely stated, however, that B. coil are rarely absent in 1 c. c., of the water and generally present in 0.1 c.c.

Elements of Water Supply Works

The existing water supply works consist of the following principal elements:

Printed as insert to Municipal and County Engineering, Chicago, Ill., July, 1919.

A timber crib dam about 7 ft. in height above the original bed of the stream on the Little Patuxent River at Welch's Bridge at the west central limits of the camp reservation.

Two separate, concrete, screened, intake chambers on the left or east bank of the stream.

A low lift pumping station on the east bank of the river with three electric motor driven, centrifugal, pumping units forcing water to five coagulating tanks at the water filtration plant. The total nominal capacity of these pumps operated singly is about 3,300 gals. per minute, or 4,750,000 gals. per 24 hours. Their capacity operating in pairs, or all together is considerably less, due to friction losses in the pumping main. Two additional pumps each having a pumping capacity of 1,650 gals. per minute have been delivered to the plant, but to the present time have not been installed. One of these is driven by a 75 h. p. motor, direct connected and the other by a 75 h. p. Van Blerck gasoline engine, direct connected.

Lime storage house and lime tank house, lime solution and dosing apparatus, located on the left bank of the Little Patuxent River at the low lift pumping station.

Design of the Rapid Sand Filter Plant

A complete rapid sand filter plant involving:

One mixing tank and five coagulating tanks, nominal capacity 100,000 gals. each.

Six Roberts Filter Company's rapid sand filters, high rate wash type, capacity 500,000 gals. per 24 hours each, complete with effluent controls, loss of head gauges, etc. (Two additional filters of the same type and capacity have been started, but the construction of these filters was stopped before the equipment was completed. A very small amount of work will be necessary to equip the plant with an additional million gallon filter capacity.)

Alum storage house, solution tanks and dosing apparatus in head house at filter plant.

Two chlorine dosing apparatus of the Wallace & Tierman Company's manually controlled wet feed type.

Two clear water tanks at the filter plant, nominal capacity 100,000 each.

Two additional clear water tanks have been started and very little additional work will be required to complete this equipment.

The high lift pumping station at the filter plant with three electric motor driven pumping units, forcing water through a Venturi meter directly into the distribution system, and into equalizing tanks about 2.0 miles distant on Hill 300. The total nominal capacity of these pumps operating singly is about 3,600 gals. per minute. Their capacity operating in pairs, or all together is considerably less. This station is also equipped with one Worthington centrifugal pump, having a capacity of 1,650 gals. per minute, directly connected to and driven by a Van Blerck six cylinder gas engine. An additional motor driven pump has been delivered to the camp, but has not been installed in the station. This pump is a direct connected centrifugal pump driven by a 150 h. p. motor.

Two wash water pumps located in the high lift pumping station near the filter house, and connection for washing with use of water from force mains of high lift pumps and distribution system. The capacity of these pumps is about 1,400 gals. per minute each, or approximately 2,000,000 gals. per day. Their capacity operating together is about 2,800 gals. per minute, or 4,000,000 gals. per day.

A complete distribution pipe system arranged to receive water by the so-called direct-indirect method, comprising 20.1 miles of pipe, mostly wood stave, varying in size from 6 to 12 ins. in diameter.

Four elevated equalizing tanks having a nominal capacity each of 100,000 gals. and four elevated equalizing tanks having a nominal capacity each of 200,000 gals. These tanks are located on Hill 300 near the extreme northerly limits of the camp.

A well equipped chemical and bacteriological laboratory, located in the head house of the filter plant.

Operation of the Plant

The operation of the water filtration plant was taken over from the contractors on Nov. 20, 1917. At that time there was no personnel in the Utilities Detachment, and the first proposition was to secure, if possible, men from the 79th Division, who had previous training along the lines required for the operation of the water filtration plant and pumping stations. At this time the pumping stations were being operated by the contractors, who worked two men in each station on twelve-hour shifts, while the filter plant was being operated under the direction of the Roberts Filter Company in the same manner.

Men having the proper qualifications were selected from camp organizations for the operation of these plants. The general idea at all times in selecting men for this department was to secure men either with mechanical, chemical, or a civil engineering training. For the operation of the filter plant especially, it was desired to secure college men, for it was easily seen that this station would require the services of trained men.

For the first six months of the operation of the plants, practically all of the time of the officer in charge was spent in the filter plant and pumping stations supervising the operation of these plants. During the period when the contractors were operating the plant practically no records had been kept on the operation of the plant and it was necessary to work out new forms and systems for all the sections of this work.

Organization of Forces

The work of the pumping station and filter plant is divided into three shifts of 8 hours each. The first shift working from midnight to 8 a. m., the second from 8 a. m. to 4 p. m., and the third from 4 p. m. to midnight. At the pumping stations two men are assigned to each shift, consisting of an engineer, and an oiler, as his assistant. At the filter plant each shift consists of a filter operator and an assistant filter operator. After April 25th, 1918, a laboratory was installed and two men assigned to work in this department. These were a chemist and bacteriologist in charge and an assistant chemist and bacteriologist.

The authorized strength of the filter plant and pumping station was 23 men, distributed as follows:

Low lift pumping station: 3 Engineers. 3 oilers.

High lift pumping station:
- 1 Chief mechanic in charge of the station.
- 2 Assistants who act as alternating engineers and oilers in the pumping station.
- 3 Engineers. 3 oilers.

The filter plant has authorized for the laboratory:
- 1 Chief Chemist and Bacteriologist.
- 1 Assistant Chemist and Bacteriologist.
- 3 Filter operators, 3 Assistants.

The operation of the plant has been under the direct observation and direction of the officer in charge of filtration who is an assistant to camp utilitiets officer, who is responsible for the operation and maintenance of all the camp utilities.

The operation of the plant is now being changed to a civilian basis subject to civil service regulations and properly trained men are being secured for the operation of the plant and laboratory. The organization will be changed somewhat since more work will be expected of the individual men on the new basis.

Plant Operated at Outset by the Contractors

While plant was being operated by the contractors the rate of filtration was constantly varying, and was determined entirely by the operation of the effluent valves, although all the filters were equipped with Simplex rate of flow controls. All

six filters were operated simultaneously, and during periods of low consumption or when only one pump was being used at the low-lift pumping station, the effluent valves were throttled in order to maintain a constant head on the filters. This level was maintained at aproximately 12 ins. below the top of the staves.

The average time of operation during this period was from 5 a. m. to 11 p. m. and the plant was entirely shut down from 11 p. m. to 5 a. m. Readings on the amount of water in storage on Hill 300 were taken by two men, who were stationed at this point, and who read the depth of water in the tanks every hour.

From Sept. 19 to Oct. 15, 1917, the alum was fed from a single temporary 6x6 ft. alum tank, placed on the filter floor, with two temporary feed lines running to the sedimentation tanks. On Oct. 15 the two alum tanks each 6x6 ft. were permanently located on the third floor of the filter plant and permanent connections were made from those tanks to the sedimentation tanks. In March, 1919, these tanks were replaced with two 10x6 ft. tanks with improved orifice feed tanks and mechanical stirrers, and all alum fed directly to a mixing tank, though a secondary feed has been provided.

The amount of alum was regulated entirely by the appearance of the floc to the sedimentation tanks and in the water as it came to the filters. No records whatsoever were kept of the amounts of either alum or chlorine added during any given period of time. The lime mixing tanks at the low-lift pumping station were not in operation at this time, and there was only one day during the latter part of October, 1917, when any attempt was made to increase the alkalinity of the water.

From Sept. 15 to Oct. 5, 1917, the filtered water was sterilized by running the solution of calcium hypochlorite into the effluent main. A 50-gal. barrel containing the calcium hypochlorite solution, strength unknown, was placed beside the effluent main. The solution was run into the main through a ¼ in. pipe, and the quantity or rate of flow was regulated by a pet cock on this line. A certain number of drops per minute were added into the main pipe line, giving a theoretical dosage of chlorine equivalent to 5/10 parts per million. This crude apparatus was replaced on Oct. 5, 1917, by two Electro-Bleach wet-feed chlorinators.

Accurate Records Kept by Utilities Detachment

When the plant was taken over by the Utilities Detachment the system, however, was changed with respect to the fact that immediately on taking over the plant accurate records were kept on every phase of the operation. The rate of filtration had not been definitely calibrated and there were no means of knowing how much water was actually being filtered in a day.

An attempt was made immediately on taking over the plant to secure accurate data on the addition of alum, and from the beginning the Hazen scale was used in determining the amount of alum to be added, supplemented by the appearance of the floc in the water. Using approximate pumping records the alum added for the first three months averaged about 0.5 gr. per gallon.

Chlorination

Chlorine was added by an arbitrary setting on the Electro-Bleach machine. This rate was so adjusted as to deliver 0.5 parts per million of chlorine. But from the beginning, before the filters had been calibrated, the chlorine was calculated from the amount of water pumped by the low lift pumping station. This, however, did not take into consideration the amount of water which overflowed down the overflow pipe in the sedimentation tanks, nor did it take into consideration the throttling of the valves on the effluent line. This error was responsible for the irregular addition of chlorine to the water, with the consequent noticeable chlorine taste in the water as delivered to the camp at some times, while at other times there would be absolutely no taste or odor. The adjustment of the chlorine machines, however, was such that at no time could there possibly be an addition of chlorine of less than .5 parts per million, though while the valves were throttled, quite frequently chlorine was added in large excess because the machine was not regulated to the change in rate of filtration.

New forms were introduced in the operation of the filter plant in February, 1918, the installation of which helped considerably toward keeping the plant in better shape in that it made it absolutely necessary for each operator to pay careful attention to every stage of the operation and make an hourly record of every addition of coagulant and of every change in the treatment. Together with this change in forms many minor investigations were carried out in order to determine the characteristics of each filter, rate controller and pump in this installation.

Laboratory Control

In the water filtration plant laboratory determinations are made of the turbidity of the raw water every two hours, and of the applied water and filtered water every hour. Determinations of the alkalinity of the raw water are made every two hours, and of the treated water every hour. Bacteriological samples are taken from each filter effluent and of the chlorinated water twice daily, and of the raw water once each day. Samples are taken from various taps throughout the camp at frequent intervals, and it is aimed to have at least one sample of tap water analyzed each day. Check bacteriological examinations are systematically made in the sanitary section of the Base Hospital Laboratory upon samples of the raw, filtered and chlorinated water, and of water from the various taps in the cantonment.

In the filter plant laboratory the bacteriological work consists of a total count at 24 hours, incubated at 37°, and a total count at 48 hours incubated at 37° for 24 hours. In the Base Hospital Laboratory all counts were made at 37°, and a total 48 hours. Presumptive tests for B. coli are made on all samples at both the filter plant and base hospital laboratories. Endo confirmations are made on each tube showing gas, by the base hospital laboratory, and quite frequently Endo confirmations are made at the filter plant laboratory.

Special investigations are made at frequent intervals by the chemists and bacteriologists in the laboratory, in order to determine any necessary changes in the operation of the plant and to check all stages of the operation.

Filter Washing

The filter washing is by the high rate water method without mechanical agitation or the addition of air. The rate is normally that produced by the operation of the two wash pumps, and may be expressed by a vertical rise of 25 ins. per minute, measured above the sand.

In their original installation the filters were equipped with only the circular wash trough, and considerable trouble was experienced from mud balls, due to the fact that the distance of horizontal travel from the center of the tanks to the troughs was too great for effectively removing the mud. This trouble has been remedied by the installation of a cross-trough in each tank, in order to decrease the horizontal distance from any point in the tank to the wash trough. These troughs were built across each filter on a diameter terminating half-way between the two wash water outlets. The usual length of washing is approximately four minutes, but due to the formation of mud balls before the cross troughs were installed, the filters were very frequently washed from 5 to 15 minutes, with a resultant very high percentage of wash water used.

When the plant was originally taken over the time of washing was determined entirely by the reading of the loss of head gauges, the point of washing being usually a reading of about 9 ft. It was very shortly found that these loss of head gauges were not accurate, and considerable trouble was experienced if the filters were allowed to reach a loss of head of 9 ft. as shown on the loss of head gauges, before being washed. A

rough general rule for the washing of the filters was, therefore, devised, based upon the turbidity of the raw water, recognizing the lack of efficiency of the coagulating tanks.

Coagulant and Lime Application

On account of the rapidly changing turbidity and alkalinity of the raw water, the matter of coagulant and lime application requires the most careful and vigilant attention. With rising stream and increasing turbidity, effective coagulation is more readily accomplished than with falling stream and turbidity. The earlier turbidity is coarser and the colloidal clay present is much more readily agglomerated and subsides more rapidly than the finer matter, containing a much larger proportion of colloidal material, which obtains later after the first flush of the storm waters has passed.

Liquid Chlorine Application

In the earliest operation of the purification plant it was attempted to treat the filtered water with a minimum dosage of 0.3 parts per million (2.5 lbs. per million gallons) of liquid chlorine. This dosage was increased to 0.5 parts per million and since about August 14, 1917, the nominal dosage has been 1.0 parts per million (8.35 lbs. per million gallons). This very large dosage has been deemed necessary in view of the contamination of the river water and the tendency of the filters to break through unexpectedly, probably due to the too great effective size of the filtered sand.

Filters

The six filters installed at this plant have a rated capacity of 3,000,000 gals. daily. These filters are equipped with a Simplex rate controller, which however, does not have a graduated beam. The distance between the inner face of the counter weight and the outer edge of the sleeve of the lever, determines the adjustment on these rate controllers.

The consumption of water in the camp during the period this plant has been operated has varied from a minimum of 1.24 million gallons to 2.65 million gallons daily, the average daily consumption having been 1.98 million gallons. This wide variation in consumption has been due in part to the extreme changes in weather which have been experienced during this period. In order to accommodate these changes in consumption it became necessary to overload the capacity of the filters, and for several months the filters were constantly overloaded about 15 per cent.

It has been the policy of all the operators at this plant to run the filters at as low a rate as possible, in order that the filters should not be overloaded, but until the additional storage tanks were installed on Hill 300 it was impossible to run the filters at a rate which was not injurious to them.

Troubles and Obstacles Encountered

There were many things peculiar to this plant experienced in its operation, and it was in the surmounting of these obstacles that the most experience was gained and the operation of the plant made more efficient. The following are some of the various troubles and obstacles encountered.

a. Lack of Storage Capacity

Lack of storage was easily the most important of the obstacles experienced in the operation of this plant. The total storage at this installation was 400,000 gals. as a maximum, and at the normal rate of consumption and filtration this allowed a maximum of five hours reserve storage. Although the total daily consumption never exceeded the capacity of the plant, the peak loads of consumption, which occurred normally at each meal and in the evening between 8 and 10 p. m. greatly exceeded the capacity of the plant, and on some days the rate of consumption for several hours reached a rate of 5,500,000 gals. per day. The effect of these high rates of consumption, coupled with the very small amount of reserve storage, made it impossible for the plant to supply the water required in camp and maintain a reserve supply in the storage tanks.

As a remedy for this condition various orders were published by Headquarters relative to the consumption of water, with the object of prohibiting bathing except during stated intervals, in order that the reserve supply might not become exhausted and greatly increase the fire hazard in this camp. In addition to these bulletins as published by Headquarters water conservation posters were designed by this Department and posted conspiciously in all the latrines and kitchens in camp.

Another attempted remedy was to decrease the amount of water passing through the various fixtures in the camp by inserting in each outlet a small lead plug with an opening approximately ⅛ in. in diameter. The normal pressure in camp varies directly with the elevation, from 50 lbs. at the Base Hospital at the extreme north end of camp to approximately 100 lbs. at the south end of the camp. The installation of these lead plugs decreased the amount of water passing through the fixtures, and consequently decreased the amount of water wasted.

In Nov. 1918 four 200,000 gal. tanks were built on Hill 300 to supplement the storage and as result of the additional storage it was possible to operate the filters at a lower rate and to maintain enough water in storage at all times.

b. Mud Balls

Considerable trouble was experienced in the operation of the filters due to the large amount of mud balls that formed on the surface of the filters, and due to various deficiencies in the installation of the water works. Among these causes were:

Lack of Sedimentation; Poor Washing—The sedimentation capacity of the plant at that time was 200,000 gals., which at a maximum rate of flow allowed a sedimentation of only one hour. This very short period of sedimentation required the addition of extremely large quantities of alum in order that sedimentation might take place before the water reached the filters. With, however, the extremely high turbidities that are found in the waters of the Little Patuxent River following storms, it was found impossible to have all the mud deposited in the sedimentation tanks, and consequently it has frequently been found that the water as applied to the filters had a turbidity as high as 300, with the consequent formation of large quantities of mud balls.

The equipment as installed provided only the circular wash trough, and the distance from the center of the filter to the wash trough was too great for proper removal of the dirty water. Consequently a large amount of mud was allowed to remain in the filter from time to time, which gradually accumulated and resulted in the formation of mud balls. Part of the time, when most trouble was being experienced in the formation of mud balls, one of the two wash water pumps was out of service and it was necessary, in order to get the proper rise, to wash with water from the mains. It was impossible in this way to secure the desired rise in the wash water, and it was during this period that considerable trouble was experienced with mud balls.

The washing of the filters has been considerably improved by the installation of center cross troughs in each of the six filters. These troughs have also materially decreased the amount of wash water required and have increased the uniformity of the wash.

c. Alum Apparatus

Considerable trouble was experienced with the alum apparatus installation. The most serious trouble was the corrosion of the galvanized iron by the alum solution. The first installation of piping from the alum tanks was a lead lined galvanized iron pipe, but the joints were not properly made, and in a very short time the iron between these lead joints was eaten away and the apparatus began to leak very badly. The new alum apparatus installation has removed these difficulties.

d. Chlorine Apparatus

The most serious trouble experienced with the chlorine apparatus was due to the type of machines installed. This installation consisted of two machines of the Electro-Bleach type, which after a very short period of service became unserviceable. The guages on these machines were found to be inaccurate, and in consequence the addition of chlorine was very irregular. Due to large amounts of impurities in the chlorine gas the machines became clogged, and repeated efforts to clear them were of no avail. The defects in the chlorine apparatus resulted at times in a very irregular addition of chlorine to the filtered water.

These machines were replaced by a Type B. wet-feed, manual control Wallace & Tiernan chlorinating apparatus. These machines had a capacity of 50 lbs. per day and were installed in duplicate. With this installation it was possible to adjust the amount of chlorine added very accurately, and no further troubles have been experienced with the addition of chlorine since their installation.

e. Mechanical Troubles

The principal mechanical troubles resulted in a decreased water supply, on account of the fact that it was impossible to pump water to the filter plant. In most cases where this condition existed the trouble was due to interruptions to the supply of electric current to the camp. The interruptions, which were of frequent occurrence, ranged in duration from a few minutes to five hours.

As a result of electrical storms two of the 2,200 volt motors were burned out at the Low Lift Pumping Station, in August, 1918, and after that time considerable trouble was experienced in keeping the pumping equipment in working order at this station. To prevent any further trouble in having motors out of service extra equipment has been installed in each of the two pumping stations. One unit in each station consists of a gasoline-driven pumping engine, each having a capacity of 1,650 gals. per minute. These additional units were further supplemented with the addition of 800,000 gals. reserve storage, which has served to relieve any shortage of water due to mechanical troubles of any sort.

f. Loss of Head Gauges

Some trouble was experienced with the loss of head guages as installed at the Filter Plant, the principal trouble being their unreliability. The faults were not so much in the design of the guages as they were in mechanical difficulties. The copper wire which supported the floats became corroded very quickly by the chlorine gas which was liberated in the filtered water and was likely to break at a time when most needed. This wire would also at times jump the wheels due to the fact that the weights would catch on the flooring or on the sides of the pipe, and in this way would wrap around the cogs outside the wheel and put the loss of head guages completely out of service. The presence of mud balls on the filter was a cause of irregular filtration and the loss of head guages themselves gave a false sense of security, due to the fact that although the filters were likely to break, the loss of head guages themselves might show a loss of head of not over 5 or 6 feet.

The unreliability of the loss of head guages had the effect of giving the filter operators a false security, in that they had been disposed to depend on the loss of head guages entirely for their indication as to the proper period when filters should be washed. These guages frequently stuck, showing a loss of head of about 5 or 6 ft., and, even though carefully checked, the operator was likely to overestimate the capacity of his filter, with the result that the filter would break and deliver a poor grade of water to the camp.

In order to determine when the filter should be washed a time limit was put on each filter, depending on the raw water turbidity. At no time was the filter supopsed to run over 24 hours, with a normal raw water turbidity of less than 50.

g. Sand

The sand that was installed in the filters was found to be too coarse to give good results when the filters were operated at a high rate. Analysis of the sand made in the laboratory of the Montebello filters in Baltimore showed the sand from the surface of the filters to have an effective size of 42 mm. and a uniformity coefficient of 1.19, while sand from a depth of 18 ins. below the surface had an effective size of 48 mm. and a uniformity coffiecient of 1.59.

The effect of the coarse sand in the filters was that the mat of the filters broke under the high rate of filtration. The result of this was that a certain amount of fine colloidal matter was allowed to penetrate through the filters into the effluent water, and unless the addition of chlorine was considerably increased the bacteriological counts in the water delivered to the camp were high, and in several instances resulted in contaminating the whole water supply.

h. Contaminated Water Supply

There were several causes which tended to contaminate the filtered water supply in this camp. Uncovered clear wells and reserve storage tanks on Hill 300 were a contributory cause of this contaminated water supply, in that these tanks frequently served as a resting place for birds, and particularly pigeons, in the vicinity of Hill 300, and the water supply was in many instances contaminated directly by the dejecta from these birds. These conditions were remedied first by covering all the storage and clear well tanks, in this way preventing any outside contamination, and, second by the purchase of new chlorinating equipment, which enabled the operators to chlorinate at a more uniform rate. The amount of chlorine was increased to 1½ parts per million during the periods when the water showed fecal contamination, which in this manner was quickly eliminated.

i. Algae in Storage Reservoirs

The presence of algae was caused by having the tanks exposed and uncovered, which made conditions very favorable for the growth of algae. The only effect noticeable was the presence of a slight odor at the tanks on the Hill, but which was not noticeable in the water supply as distributed to the camp. The tanks were thoroughly scraped out, the algae growth removed and the tanks treated with a solution of copper sulphate as a disinfectant, and covered. No trouble has been experienced with algae growths in these tanks since that time.

Records

A card system for records of the pumping stations and filter plant has been installed. On these cards the pumping station operators are required to note the time of starting and stopping of each pump. The revolutions per minute, the vacuum and pressure on each pump are required to be recorded every hour. At the low-lift station when lime is being added a record is made each hour of the lime added. On these cards are also entered any extraordinary happenings pertaining to the operation of maintenance of the pumping stations. During the period of construction a daily progress record on this construction is entered on the daily record card.

At the filter plant in the same manner is recorded the time of starting and stopping of each pump in both stations, as well as the time of starting and stopping of each filter as it is put in service or taken out of service. Every hour a record is made of the amount of chlorine added to the effluent, the amount of alum added to the raw water, and the amount of storage, the amount of water consumed, the alkalinity of the raw water and the turbidity of the raw, applied and filtered waters. At each hourly reading a record is made of the loss of head as shown on the loss of head guage for each filter, and the rate of filtration is recorded, depending on the setting of the rate controller.

Reports

A summary of all the daily records is made on a large blue-printed form, originated by this organization, which gives a complete record for the month of the operation both at the filter plant and pumping stations. This report includes the chemical and bacteriological record, as well as the plant operating data.

Costs

Operating costs have been figured for the whole period of operation since the work was taken over by this detachment. The costs as computed for the year 1918 do not include repairs and supplies, but are based only on the total pounds of alum, lime, chlorine, coal, power costs and salaries. The average cost per thousand gals. filtered during the year 1918 was 7.6 cts.

Alum cost $1.85 per 100 lbs.; lime $12.75 per ton; chlorine, 8.6 cts. per pound and coal $5.80 per ton.

The general operation of the Camp Meade Filter Plant is favorably comparable with any mechanical filter plant of its size in the country. Operating costs are a trifle high due to double pumping and large amounts of coagulants necessary for the water.

The original installation was inadequate for the needs of the camp, but the additional equipment authorized and installed during the latter part of 1918 has made ample provision for any emergency.

Some Experiences Gained in the Private Ownership of the Public Water Supply Works at Council Grove, Kansas

By Louis L. Tribus, of Tribus and Massa, Consulting Engineers, 15 Park Row, New York City

(Mr. Tribus has been for twenty odd years engineering adviser to the Council Grove Water Supply Co.; its owners all being Eastern men who invested unwisely, but in good faith, being misled by the promoters.—Editor)

The recent sale to the city of Council Grove, Morris County, Kansas, of the privately owned water system closes the first volume in the history of an interesting little plant, which in some ways is typical and in others unusual, a plant having capacity of about one-half million gallons per 24 hours.

In the decade, 1880 to 1890, hosts of villages, small towns and partly grown cities fell to the blandishments of water works promoting syndicates and enterprising individuals.

Some instances there are where honorable dealings prevailed, suitable construction ensued and happiness continued, but many are the unfortunate cases where these desirable features are lacking.

Occasionally, condemnation proceedings bring to light some such unfortunate conditions, but usually they remain locked in the memory of gulled investors, who try to forget their losses and do not desire to exploit their mistakes or deficient judgment.

Council Grove is a case in point, except that its construction work was good in quality.

Volume II of its history can only be written after the lapse of coming years as a municipally owned and operated utility.

Source of Supply

The Neosho river is a flashy western stream, flowing through rolling farms and grazing lands, over a limestone rock bed and between (usually) banks of rich black silt.

In the course of a few days, and without any regularity of season, it changed from a bank full, swiftly flowing stream, fifteen or more feet deep, to little more than a trickle from pool to pool.

Nature has developed these pools, through the deposit of cementitious gravel, making dams or riffles at about ½ mile intervals.

Man has taken advantage of them and for Council Grove's supply has raised them higher; in one instance with a masonry core and paved top and slopes, and in another with a rock-filled crib and planked structure.

Until within a year or two almost enough water has been thus impounded to tide over dry spells, unless the demand was too great, then great anxiety followed until rain or thaw brought relief. On parts of two days the city actually was without fire protection, for the water fell too low for the pumps to reach it; but surely a pretty good record for a region of droughts and a life of 32 years.

With the topographic and geologic conditions as noted, variation in quality of water is not surprising. At low stage, very high in alkalinity and moderately clear (spring flow chiefly); in flood, low in alkalinity and high in everything else that can find passage in an active Kansas stream; turbidities then running up to 5,000 parts per million and over.

The first elements of the original plant consisted of the usual steam pumping station, drawing water (untreated) from the lower pool (or reservoir), with some storage above the crib dam, before referred to; some 4½ miles of good sized cast iron pipe lines; a wrought iron standpipe 20x80 ft., surmounting the one eminence in the city, and an all important feature, a 25-year franchise and hydrant contract; the latter carrying terms, strange to say, just, both to the city and the prospective company.

VIEW OF THE WATER SUPPLY WORKS AT COUNCIL GROVE, KANSAS.

Left to Right: Pressure Filter House (1898)—Old Boiler and Pumping Station—New Filter House—Coagulation Gallery and Sedimentation Basins (1915)—Old Receiving Well at edge of Neosho River.

Water Rates Copied Bodily from St. Louis, Mo.

The rates, however, authorized in agreement under, but not required by, the franchise, were taken bodily from those in effect in St. Louis, fair perhaps in that large city, but scarcely one-third of what they should have been for a small place like Council Grove.

It was quite within the legal powers of the mayor and commissioners to arrange with the company from time to time for an adjustment of these rates to meet conditions of the day, but no justice could ever be secured for the company; the attitude of the officials being "if the company made a bad bargain let it take the consequences—we know a good thing when we see it—we have the best plant in Kansas and the lowest rates, let the company get better terms if it can, etc., etc."

Without filtration, it can be well imagined that the use of water was limited chiefly to lawn sprinkling (and fertilizing, though the rates did not consider that valuable feature), street flushing and such manufacturing as could not

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CAST IRON PIPE
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There is very little, if any, Cast Iron Pipe in the ground today that could not be "scrapped" and sold for more than its original cost—it is made of the only material to which *age gives an appreciated value*—but it is never "scrapped." It is taken up intact and relaid in some less populous section of the city.

THE FIRST CAST IRON PIPE EVER MADE IN THE WORLD'S HISTORY IS STILL IN SERVICE
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With the ever increasing cost of labor, wouldn't it be much better to err slightly on the side of "ample capacity" and save this expense of replacement?

The Cast Iron Pipe Publicity Bureau

1 BROADWAY **NEW YORK**

secure enough from shallow driven wells; the two railroads were large users for locomotive boilers, but of necessity not desire. Housholders depended largely on roof collected rain water and shallow wells, but both very precarious sources; they denied themselves, almost wholly, sanitary conveniences.

After Ten Years

After waiting in hopefulness for some 10 years or so, the unfortunate and largely uninformed non-resident owners of the plant, misled by the promoters, found a costly non-earning property on their hands and the necessity of providing additional storage and filtration, or risk losing the whole investment.

By the way, it should be noted that the same mayor, now in the chair, after several breaks in continuity of service, and into whose official hands the present plant falls, was in office when the original franchise was granted in 1886, approved the plans for the first plant and to him and his followers is largely due the disgust, that has caused the sale at a sacrifice, so as to end such unsaticfactory relations as have obtained for years past. Good treatment and honorable dealings have been consistently met by vacillation, repudiation and injustice. These comments are strong but fully justified and should be an integral part of the record.

Improvements Made to Plant in 1898

In 1898, additional storage was provided and a rapid mechanical pressure filter installed.

These facilities satisfied the slowly increasing consumption, but housewives could scarcely get themselves to use "that nasty river water," even though it came clear from the tap, as long as roof washings instead, would hold out. It may be said in extenuation, however, that the roof water was "soft" and the public supply "hard," and that when heated the latter, though clear, did at times smell of its early days.

When, however, the shallow driven and dug wells gave evidence of outhouse contamination, and the city, in its growing pride, achieved a sewer system, the Board of Health asserted itself, closed the wells, ordered sanitary facilities, sewer connections, and through force of necessity, water services.

The company began to get increased business but with existing rates, increased expense also, out of proportion to the increase in revenue.

More Plant Improvements in 1911

The end of the franchise came in 1911; the city gave formal certified notice of its intent to acquire the system; its officers agreed upon a fair price, them the voters diligently misled, repudiated the action and the officials discontinued to pay hydrant rental until forced by the court either to acquire the property and pay the claims or extend the franchise and contract, for a 20-year term. It chose the latter, and the company in accepting, and compromising on past earned hydrant rentals, agreed to enlarge the treatment plant and forthwith did design and build, what perhaps has been the most effective purification plant of its size in the West; a plant where at all times the river water, foul as it sometimes flows, is transformed into a clear, sparkling, safe, sterile beverage. Sulphate of Alumina as the reagent, sedimentation and finally filtration and sterilization with Hypochlorite of Lime, briefly covers the process, but intelligent handling has been the controlling factor. The noteworthy feature in the process, is the use of coagulant at different points in the travel of the water through the plant, so adjusted in doses as to avoid large quantities, yet to cause precipitation of sedimentary matters, at, so far as possible to determine, just the right places, and save undue work of the gravity mechanical filters.

A "clear water" well holding 50,000 gals. and a standpipe 160,000 gals., fairly well equalize the fluctuating draft and steady the pumpage.

Rather interesting, as showing good material and careful handling, is the fact that the two compound Davidson steam pumps installed in 1887 are still working smoothly and doing their daily duty in 1919, and the pair of original tubular boilers, still approved by the insurance inspectors, is still in service, though augmented by a new and larger boiler set in 1915.

A "Scrap of Paper"

In 1915 the company went to a large cash outlay to provide the additional facilities, under a "Gentlemen's Agreement" with the city officials, to the effect that immediately following successful completion and satisfactory test, the city would authorize a revision upward of domestic and manufacturing rates, so as to produce a reasonable income on the total valuation of plant in service.

So as to be perfectly fair the company asked the State Board of Health, which had power to approve or reject the plans, to take charge of the test of the finished plant.

Such test was held, and in June, 1915, the Kansas State Board of Health gave formal approval by certificate, yet in spite of many requests, submission of revised schedules of rates, etc., the officials failed to accord any changes, or even formally to consider and discuss the subject, but now after the ripe plum has fallen, one of the first steps taken, is a movement to amend the charges.

Oh, What's the Use!

A course of legal action might have been instituted at large expense, and through ultimate appeal through court and Public Utilities Commission, justice might perhaps have been secured; but the Kansas Public Utility Laws only contemplate redress to a Water Supply Corporation after all other possible actions fail, so that the company saw only extra expense ahead, with an uncertain result for the future and no equalization for the costs and losses of the past.

Financial Summary

A brief summary in general percentages may be more enlightening and illustrative than the totals of dollars involved:

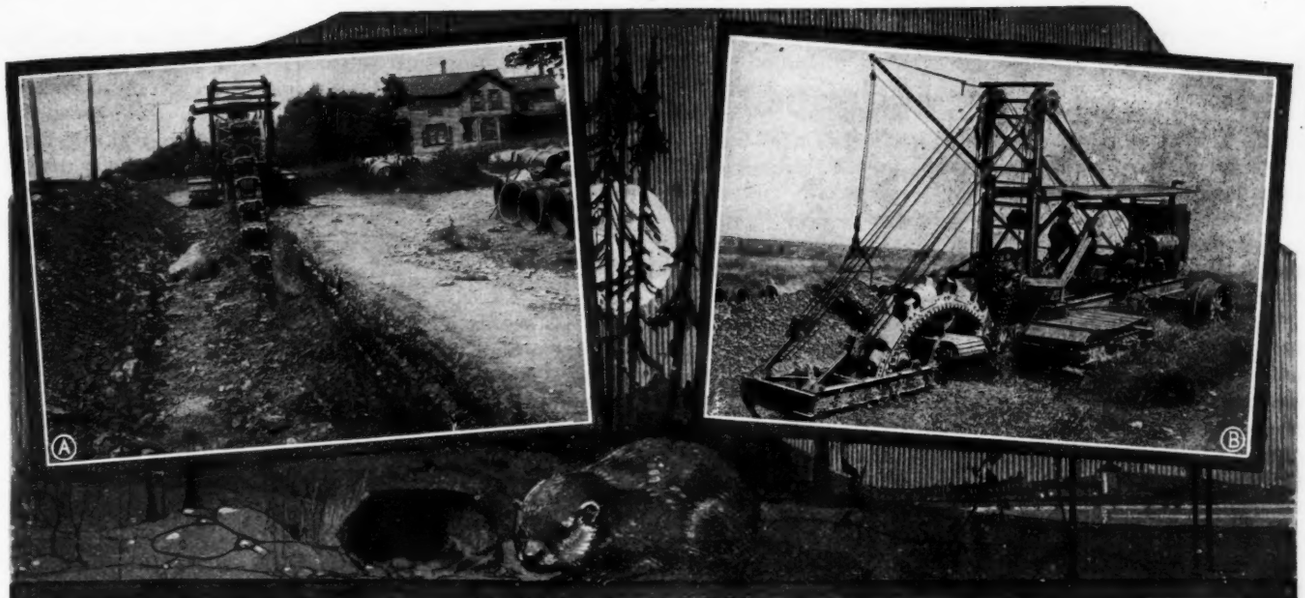
Original investment plus later capital expenditures	100%
Of the original investment probably 30% was virtually misappropriated or misapplied by the promoters, so that the investment value of the present plant would be, to total outlay, say	83%
Allowing for depreciation, though the upkeep has been in general excellent, the fair percentage for present value of total invesment, though not crediting the plant with all the present high prices, but a fair mean of the past five years, would be	70%
Accepted in full payment by the company; percentage of total invesment, about	40%
Percentage of depreciated real value as paid by the city, about	57%

In computing these values, no allowance is included for "going value," "recovery of franchise," or any other "intangible" asset.

Non-Resident Owners Highly Taxed

The city has taxed the company for years, upon an equal or greater valuation than the sum finally paid for the system, yet taxation in general through the city has been more nearly on a 50% basis, though theoretically perhaps on full value system—comment, non-resident ownership.

Some of the losses, for an average of less than 3% net has been realized on the original outlay during the 32 years of operation, could have been saved through a still greater capital invesment for more economical machinery, and probably by litigating rates years ago, but in view of the long-distance ownership and the unsatisfactory dealings with some of the city officials, the company has been ever disinclined to send more good money after bad, except as imperatively necessary, and finally took the loss rather than continue a very unsatisfactory holding.



GROUND HOGS

—because they open up trenches quickly and neatly! Look them over.

A—This is the Ladder Type P & H Excavator making a ditch thru hardpan and boulders for a contractor down in Illinois. It's a powerful machine, fabricated of steel thruout, designed for sewer digging and general heavy trenching to 20 feet in depth.

B—Is a Wheel Type P & H Excavator opening the ground for a drain pipe-line. This is the outfit for pipe-line, conduit, and farm drainage excavation. Built of steel for light weight and flexibility; digs trenches 7½ feet deep to 28 inches wide.

C—A machine with a multitude of uses—the 205 Dragline P & H Excavator. What it will do: Excavate open or sloping bank ditches, clean out old ditches, dig cellars and holes, strip coal, grade streets, backfill trenches, load or unload coal, crushed rock, screenings, sand or gravel, and last, but not least, it is a complete, portable locomotive crane with a lifting capacity of 3500 pounds.

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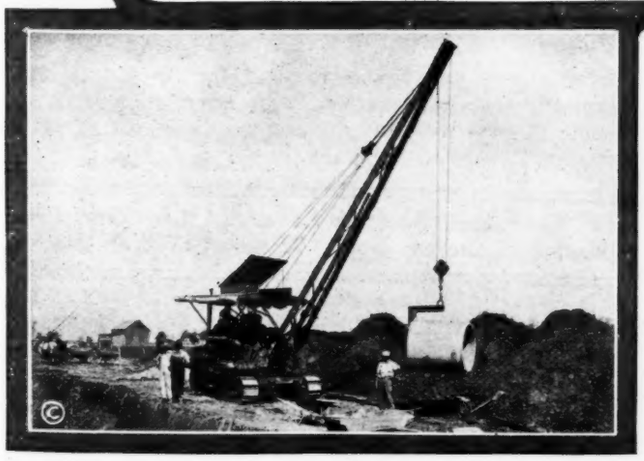


In some other states, public utility commissions are beginning to treat the relationships between communities and their citizens and public service corporations on a basis of mutual interest and justice, so there is hope for the future, but many a case like that described herein has gone into unwritten history, but some day a never failing retributive justice will even up the irregularities.

Council Grove will now spend probably $25,000 in further changes—electrifying the pumping, extension of sedimentation basins, additional storage, etc., and the citizens will have to pay higher rates or higher taxes.

So far as many experiments have demonstrated, the Neosho river is the only possible source of adequate water supply, so the continued history of the works will be of interest to sanitarians, particularly, as changing the color of water with malt preparations, becomes a process of the past, and bright, clear, sparkling beverages, without foam, become more popular; of course Kansas has for some years past stood for water alone.

Points for Engineers and Investors to Consider

Most reports of water systems tell of new plants just built or extended—the foregoing facts and review, however, may not be amiss, and may emphasize to engineers, the desirability of more thoroughly studying a community's personnel, franchise terms, probable earnings, possible financial conditions, existing laws and trend of opinion, etc., as well as the more technical ones of supply and construction possibilities and costs.

Successful Use of Cement Joints for Cast Iron Water and Gas Mains

By Stephen E. Kieffer, Consulting Engineer, Mechanics Insitute Building, San Francisco, Cal.

In the construction (just completed) of the United States Housing Corporation Project No. 581, at Vallejo, Cal., for the Mare Island Navy Yard, a very successful use was made of cement joints in laying the cast iron water and gas mains.

The decision to use cement instead of lead for the joints was arrived at after a very careful study of the whole situation, taking into account the records of the best practice available, particularly on the Pacific coast. The saving in cost of cement over lead, at its then maximum war cost, was not the material factor in this case that it might be on a private project in peace times, and received little consideration.

The Construction Methods Employed

The methods of construction used and results obtained are interesting.

Oakum or jute not being regarded as satisfactory to use with cement it was decided to use hemp rope, and discarded slings made from ½ and ¾ in. tarred rope were obtained from Mare Island Navy Yard. These were old, dried out and very stiff, and after being cut into required lengths for use were unstranded and the strands loosely retwisted and rolled by hand, thickness depending on the size of joint to be caulked.

It is considered that upon the use of this particular type of packing rests the success of the work, since this—rather than the cement binder—is relied upon as the water and gas tight element in the joint.

Great care was taken to see that all pipes as laid were solidly blocked in order that there would be no movement of the pipe line during and after making the cement joints and earth was tamped around and over the pipes between joints.

One and sometimes two strands of the retwisted hemp rope was inserted in the bell of the pipe and this rammed in hard by caulking. A mixture of cement and sand, in the proportion of two parts cement to one part clean sharp sand with enough water added to make a dry paste which when balled and squeezed in the hand would barely exude moisture, was then inserted in the bell, pressed in first by hand until the bell was about half filled, and then caulked as a lead joint would be caulked, until the caulking tool would barely penetrate the cement and the joint would ring. More of the cement paste was then inserted and the caulking repeated, leaving the joint filled to within ½ in. of the face of the bell. A strand of the retwisted hemp rope was then laid around the bell and this caulked in flush with the face of the bell. The joint was then wiped with cement paste containing sufficient moisture to mould and was bevelled off.

Each joint after making was kept wet, by covering with pieces of old sacks, for at least 36 hours, after which the pipe line was slowly filled and allowed to stand under normal pressure which was never greater than 70 lbs., for at least two days before the test pressure was put on.

Two thousand feet of 10-in. water main and 400 ft. of 8-in., 6-in. and 4-in. pipe were included in the first test and 50 per cent. of the joints leaked after subjecting same to the normal pressure. These leaks ranged from a slight sweating to a steady drip which filled the bell holes and covered the pipe. During the following three days most of the leaks stopped and we decided to cover and backfill the whole pipe line, as the character of the ground was such that any leak would come to the surface, and let the pipe line remain under normal pressure for a week or two before putting on the test pressure of 125 lbs. The dry hemp rope undoubtedly absorbed moisture and swelled, thereby stopping all leakage. All leaky joints took up with two exceptions both of which upon being cut out and examined were found to have been very carelessly made. These were remade and the line when tested showed no leakage.

As the work progressed and workmen, who were unskilled Italian laborers, became more proficient the work was not only speeded up but better results obtained.

Remarkable Results Secured

A total of 20,770 lineal feet of 4, 6, 8, 10 and 12-in. cast iron pipe was laid on this project for water and gas distribution and only six defective joints had to be cut out and remade. When the pipe line could be drained the joint was remade with cement, but a few joints were cut out and remade with lead wool in order not to delay progress.

As it was necessary to pave the streets immediately upon completion of the sewer, water and gas mains and services, the pipe lines were subjected to a severe test on account of the heavy teaming and heavy steam roller working on the subgrade, but not a single leak developed. The paving was completed in January and the first leak has yet to develop.

To anyone familiar with pipe laying and maintenance using lead joints this record should appear remarkable.

As far as could be ascertained from observation and cost records kept, the labor cost using cement joints should be slightly less than for lead joints. The cost of cement and sand per lineal foot on small sizes of pipe is negligible and the money saved on this project was considerable as the price of pig lead when this work was started was almost at its highest peak.

The author was project engineer for the United States Housing Corporation, and Mr. Philip Schuyler, Asso. M. Am. Soc. C. E., was assistant engineer in direct charge of construction.

The Need and Cost of Covering the Clear Water Basins of the St. Louis, Missouri, Water Works

By Cornelius M. Daily, Engineer in Charge, Supply and Purifying Section, Water Division, Department of Public Utilities, 34 East Grand Avenue, St. Louis, Mo.

The water supply for the city of St. Louis is taken from the Mississippi river whose turbidity varies from a maximum over 5,000 to a minimum of 8 with an average of over 1,200

and the water has a bacterial content on gelatine at 20 degrees C., varying from a maximum of 100,000 to a minimum of 3,000, per cubic centimeter. This water by chemical treatment and filtration has its turbidity and bacterial content reduced to a degree comparable to the purity of some manufactured articles, advertised as 99.99 per cent. pure. Can this purified water be stored in uncovered reservoirs without losing some of its virtuous qualitites?

This question may be truthfully answered yes or no depending on conditions, such as the duration of the time of storage, circulation of the water, its temperature, etc.

Local Ideas of "Clear Water"

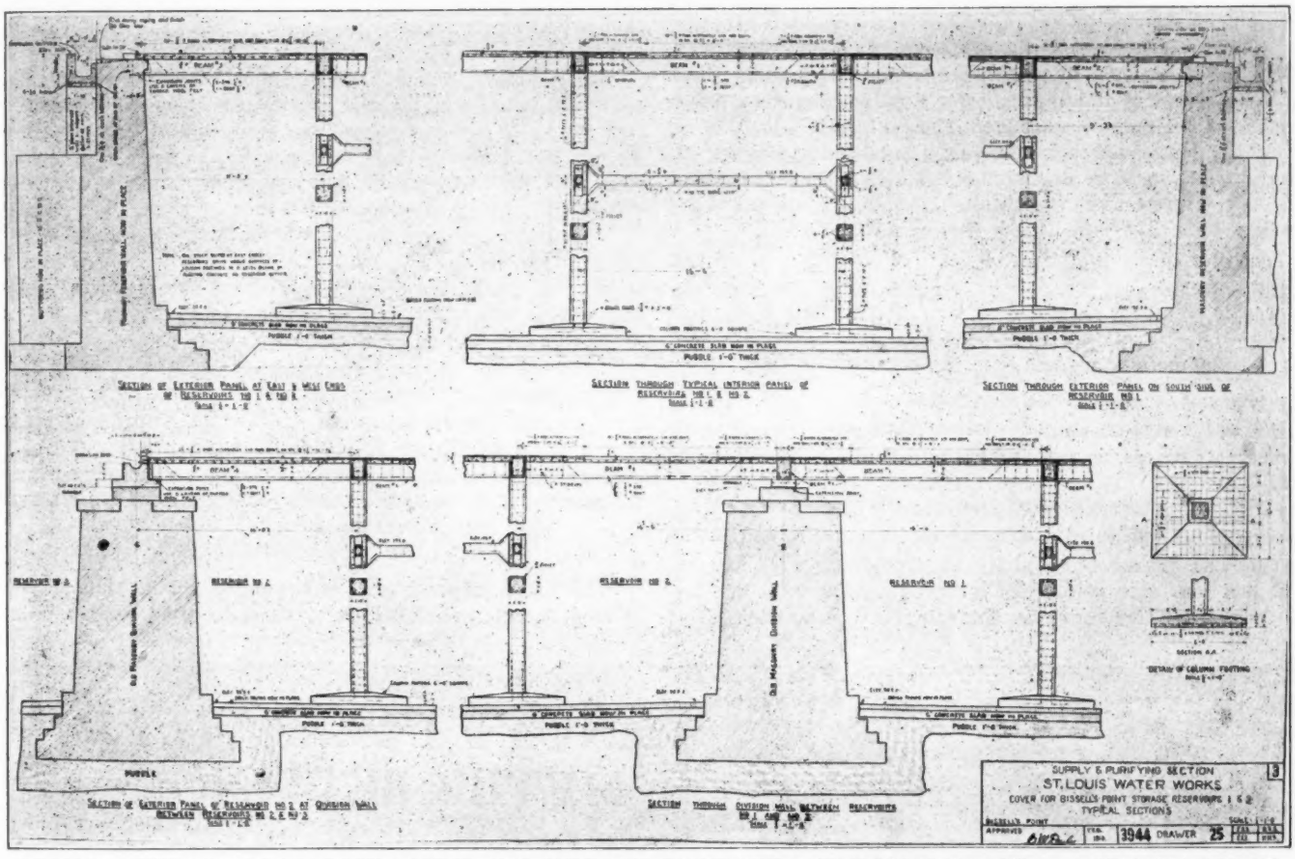
Prior to May 1915, the date the filter plant was put in operation, the thought of covering the clear water reservoirs was dimissed as a passing fancy, if such a thought ever occurred to anyone, a reason for this supposed thought, or lack of thought, was the fact that the name clear water reservoir was a misnomer. The common standard of clear water prior to 1904, when chemical treatment was started, may be described as water in which mud would not settle in a glass during the time the observer was drinking it. If mud settled in the glass during this time the water was considered not clear. A higher standard of clear water was in vogue from 1904 to 1915. The name clear water during this period was applied to water with a lemonade hue and capable of standing in a glass several hours without a deposit of mud in the bottom.

Sunlight only penetrated a few feet in clear water of these standards, algae and organisms were unknown in the reservoirs and a few thousand, more or less, bacteria per cubic centimeter did not matter a great deal. The people were accustomed to it and with a feeling of contempt for modern improvements, like the hunter who preferred a sawed off trunk of a tree rather than a new rocking chair presented him by his friends, they complained of bad taste of the water when the filter plant was first put in operation and water of zero turbidity was furnished them.

Organisms Present in Uncovered Reservoirs

Since 1915 the clear water reservoirs are holding water of zero turbidity, sunlight penetrates to the bottom, algae growth clings to the sides and bottom, and where the circulation is poor, organisms in multitudes abound. These organisms are described by our chemist, Mr. Graf, as ranatra quadridenta, water beetles, aphodius fossar, hydrophilus piceus and dysticus marginalis. Diatoms, protozoa, rotifera, crustacea, daphnia and snails. Diatoms have been known to be in the clear water in such quantities that it would clog a filter bed in a few hours if allowed to pass through it.

Various attempts to kill the organisms with a treatment of copper sulphate (1 part in 3,000,000) was more or less of a failure in hot weather, as it usually leaves a musty odor in the water and immediately the bacterial content rises to an alarming number, as many as 60,000 per cu. cen. have been found. Chlorine has been added to the water after the treatment of copper sulphate, but to get good fresh water the remedy relied upon to give satisfaction is to waste the water with its menagerie, clean the reservoir and start over again. This has been done many times since 1915 and probably will continue in warm weather until the last of the clear water reservoirs are covered.



TYPICAL SECTIONS OF PROPOSED COVER FOR BISSELL'S POINT STORAGE RESERVOIRS NOS. 1 AND 2 OF THE ST. LOUIS WATER WORKS.

There are seven clear water basins uncovered in St. Louis, one at Baden holding 25,000,000 gals. of water, four at Bissell's Point holding 50,000,000 gals. of water and two at Compton Hill holding 85,000,000 gals.

A small basin holding 10,000 gals. at the filter plant was covered in 1916 after considerable trouble was experienced with algae growth on the sides and bottom. Since it was covered no further trouble developed.

The reservoir at Baden holding about ½ day supply gave a great amount of trouble during the summers of 1915, 1916 and 1917 from organisms, but was not troublesome last year when all the water used at this station entered the reservoir, at one side and taken out at the other instead of floating on the line leading direct to the wet well, where the pumps draw their supply, as it did from 1915 to 1917. At Bissell's Point the reservoirs hold about 2/3 day supply and our experiences with the organisms and bacteria are similar to the ones encountered in the Baden reservoirs.

It is evident that with a small supply reservoir where the entire water is changed every day little trouble would be experienced from organisms; algae, on the contrary, would not be affected and in time might be troublesome. The water at all times would be exposed to contamination by bacteria.

At Compton Hill the reservoirs hold about 85,000,000 gals. and act as a storage pressure reservoir for the low pressure distribution system. Trouble with organisms and bacteria has been experienced each summer since the filter plant was put in operation. Circulation is impossible and water may remain in parts of the reservoir for days serving as a quiet breeding place for all organisms. The rapid multiplication of these organisms may be assisted by a partial development of the organisms in the water pumped from Bissell's Point reservoirs but the fact remains that ideal conditions are found in the Compton Hill reservoirs for their growth.

I do not mean to convey the impression that it is unnecessary to cover clear water reservoirs when the water is allowed to stand for only a short time, for bacteria is carried by the wind, by animals and birds into open reservoirs and may become more dangerous than the organisms.

Types of Cover Considered

Our water commissioner, Mr. Wall, had caused several types of reservoir covers, as early as 1916, to be designed and their costs estimated. Three general schemes were investigated. The first was a wooden roof, the second a concrete roof with 2 ft. earth fill, and third a concrete roof without any fill.

The wooden roof could only be considered a temporary structure and the maintenance cost was high and the scheme was abandoned for a permanent concrete construction.

A concrete structure supporting a 2 ft. earth fill is very desirable but costly and several types were designed.

The concrete construction not supporting an earth fill was found to be much cheaper and leaving aside the question of a park on the reservoir site, it is the most desirable cover.

Estimated Cost of Various Concrete Covers

The estimated cost for the various concrete covers based on present day prices are listed below for Bissell's Point and Baden reservoirs. The cost is given per square (100 sq. ft.):

Flat slab, groined invert footings for 2 ft. earth fill	$ 93.50
Flat slab, groined invert footings A. K. M. E. system for 2 ft. earth fill	97.00
Flat slab cover and footings for 2 ft. earth fill	108.00
Beam and slab, two-way reinforcing for 2 ft. earth fill	107.50
Flat slab, reinforced footing, without earth fill	70.00
Beam and slab, two-way reinforcing, without earth fill	64.00

From the above figures it is evident that the beams and slab two-way reinforcing without earth fill is the cheaper construction.

An ordinance for appropriating money to cover Baden reservoir and two of the four at Bissell's Point with concrete beam and slab two-way reinforcing is now under consideration by the Board of Aldermen and should the appropriation be made St. Louis will have taken a long step in furnishing its people with pure and wholesome water.

The accompanying illustration shows typical sections of the proposed covers for Bissell's Point reservoirs. The proposed covers for Baden reservoir are identical excepting the footings which are plain concrete extending to bed rock a few feet below the bottom of the reservoir

Design and Construction of the Water Supply System of Camp McClellan, Alabama

By Maurice R. Scharff, Assoc. Am. Soc. C. E., Asst. Chief Engineer with Morris Knowles, Inc., Jones Bldg., Pittsburgh, Pa.

The water supply system of Camp McClellan, Alabama, described in this article, is the system designed and installed

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for the originally authorized National Guard Camp for one division, constructed during August, September and October, 1917, during which period the writer served as engineer in charge for Morris Knowles, Inc., Supervising Engineers; subsequently after the writer was called to active service with the Corps of Engineers in France, extensions and additions were made to the distribution system; and at the time of the signing of the armistice, a project for a new impounded supply, and reconstruction of a considerable part of the system, to take care of proposed enlargement of the camp, was under consideration. But, in general, no extensive changes were made in supply works or the distributing reservoir, so that substantially the works described herein have continued to serve the camp up to the present time.

Basic Requirements Controlling Design

The basic requirements for the water supply of the camp were largely fixed by the instructions to constructing Quartermaster issued by the engineering division of the department of cantonment construction at Washington. This included the specification that the system should be capable of delivering an average of 30 gals. per capita on any one day and a maximum for one hour of 2.85 times the average. It was. of course, expected that the quality of the supply should be unexceptionable.

The original instructions covered the construction of the camp to contained about 34,000 men, which at 30 gals. per capita would require an average daily supply of 1,200.00 gals. per day. It was not clear whether the instructions contemplated that this should be the average or the maximum daily consumption to be provided for; or, if for the average, what allowance should be made for seasonal and weekly variation in daily draft. It was believed, however, that there would be a substantial variation in daily draft, and it was finally concluded that the safest plan would be to take the prescribed per capita allowance as an average and make provision in the design for an excess of 50 per cent. on the day of maximum draft. The system was, therefore, designed to provided a maximum daily delivery of 1,500,000 gals.

Source of Supply

The rapid study of the situation made upon the writer's arrival on the ground on June 16, 1917, led to the conclusion that the only source from which a sufficient supply could be obtained within the time limit fixed by military necessity was the system of the Alabama Water Company, which supplied the city of Anniston.

This system takes its supply from Coldwater Spring, located about seven miles northwest of Anniston—one of the great limestone springs of the lower Appalachians, with a minimum flow of about 25,000,000 gals. per day. The pumping station, at the beginning of the construction of the camp, contained two old Holly steam pumps, each of 3,000,000 gals. per day capacity (one of which was removed and sold for scrap in August, 1917, while the other was held in reserve as a spare); and a 10-in. Worthington turbine pump, direct connected to an electric motor and designed to deliver 3,000,000 gals. per day against a pressure of 165 lbs. per square inch.

The pumping station delivered water through a 20-in. cast iron main to a 7,000,000 gal. distributing reservoir, from which a 16-in. main supplied the distribution system. A 10-in. main of the distribution system supplied an industrial plant and a small village at Blue Mountain, and on this main, the nearest to the camp site, it was determined to make the connection for the camp supply, reinforcing the distribution system sufficiently to deliver the required quantity to this point.

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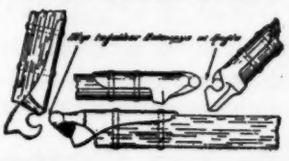

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Pumping Equipment

The new construction included the installation of three belt connected electric motor-driven centrifugal pumps in the Coldwater pumping station of the water company—a Buffalo pump, designed to deliver 1,500 gals. per minute against 430 ft. head; an Alberger pump, designed to deliver 1,035 gals. per minute against 430 ft. head; and a Hill pump, designed to deliver 1,750 gals. per minute against 430 ft. head; the construction of a 10-in. reinforcing main 6,500 ft. long, tapped into the water company's 16-in. main under pressure by means of a Smith tapping machine; the installation of a booster pumping station including three pumps—two of them (one a Hill, the other an Alberger) designed to deliver 500 gals. per minute each against 225 ft. head and direct connected to electric motors; and a Buffalo pump, originally designed to operate at 1,500 r. p. m. and to deliver 1,050 gals per minute against 430 ft. head, but belt connected to an electric motor so as to operate at 1,040 r. p. m., and to discharge about 1,000 gals. per minute against 225 ft. head; the construction of a 10-in. cast iron force main 25,000 ft. long; distribution systems for the divisional camp, the base hospital and the remount depot, containing 5,790 ft. of 10 in. pipe, 8,870 ft. of 8 in., 61,900 ft. of 6 in., 2,560 ft. of 4 in., 5,080 ft. of 3 in. and 98,975 ft. of smaller service lines; and a distributing reservoir of 800,000 gals. capacity, originally designed to be lined with concrete, but constructed without lining on account of the unusually impervious character of the material in which it was excavated.

Influence of Time Element on Design

The conditions under which this work was done, illustrate very well the controlling influence exercised by the time element in the cantonment construction work, and the extent to which designs and construction methods were controlled by considerations other than those which would apply in ordinary practice. The choice of the source of supply, for example, was absolutely limited by the time element. For, while later studies for the enlargement of the camp went into the possibilities of spring supplies, deep well supplies and impounded surface supplies, all of these had to be ruled out from the first consideration because of the obvious impossibility of assuring a supply from these sources prior to the arrival of the first troops.

The design of the reinforcing and force mains were similarly affected. The water company's distributing reservoir was located at such an elevation as to give a static head at the camp site of over 50 lbs. per square inch. The largest size of pipe which there was any possibility of obtaining within the requisite time, however, was 10 ins. in diameter, and this size was selected on the basis of possible deliveries, without regard for the fact that theoretical computations appeared to indicate that a larger size might have been more economical. With this size of pipe, it was estimated that, at the assumed maximum daily rate of draft, 1,500,000 gals. per day, a pressure of not less than 30 lbs. per square inch could be maintained at the site selected for the location of a booster station, which would be sufficient to maintain domestic service to the sections of the city and suburbs dependent upon this portion of the distribution system; and that by raising the pressure at the booster station to 130 lbs. per square inch this quantity could be delivered to the camp with a resultant pressure at the camp site of 50 lbs. per square inch.

Another feature of the Camp McClellan water works system which was controlled entirely by the time limit set for completion was the location of the 10 in. supply main, which followed, for the greater portion of its length the existing tracks of the Southern Railway and the connecting line constructed

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for the service of the divisional camp. A location approximately 4,500 ft. shorter would have been available by following some of the existing country roads, but as these roads were practically impassable for heavy traffic, it would have been impossible to complete the delivery of the pipe within the time limit fixed by military necessity.

Foundry Renders Great Service

The rapid delivery of the pipe required for the 32,000 ft. of reinforcing and supply mains, and their completion and connection within ten working days must be ascribed largely to the authorization by the Washington office of the use of cast iron pipe and to the co-operation of the Superintendent of the Anniston Foundry of the United States Cast Iron Pipe & Foundry Company. This company furnished from its Anniston, Chattanooga and Bessemer foundries all of the pipe in the line, except about 5,000 ft. of Universal pipe, and when completed the line contained, in addition to the Universal pipe, Standard Bell and Spigot pipe of Classes A, B, C and D; Standard gas pipe of two weights; and several thousand feet of 9.8-in. (25 centimeter) pipe of special quality which had been cast for the Argentine Republic. Not only did the foundry superintendent devote a large part of his time to securing these deliveries, but, in addition, he arranged for the use of the foundry pipe crane, much of the time under his personal supervision for distributing over 20,000 ft. of pipe along the trench from the railroad, with a maximum rapidity and a minimum of breakage.

The service of the Anniston Fountry was also of the greatest value in securing rapid delivery of special castings, and even of flanged castings. On one occasion, while additional pumps were being installed in the Coldwater pumping station of the water company, a crack was discovered on a Sunday afternoon in a 16x10-in. reducer. The superintendent of the foundry was reached on the telephone and on Monday morning the completed casting, faced and drilled and still hot from the molds, was delivered at the pumping station over 8 miles of country road. This service permitted the casting to be placed in position and pressure restored by 4 o'clock Monday afternoon.

Early Methods of Regulating Pressure

The early operations of the Camp McClellan water works system produced interesting examples of the difficulties due to the peculiar character of water consumption in military encampments. The pressure from the City distributing reservoir was sufficient to deliver the quantity necessary for night use and the requirements of the first troops which arrived on the 15th of August without booster pumping; but after the completion of the installation of the first booster pump on August 19th, it was necessary to operate the booster pumping station throughout the day, every day, from about 5 o'clock in the morning to 7 or 8 o'clock in the evening. This method of operation was sufficient to permit the continuous maintenance of satisfactory service after the completion of the camp distributing reservoir on October 13th; but until that time much difficulty was experienced in maintaining service, due to rapid fluctuations in pressure resulting from the large variations in hourly use.

Prior to the completion of the reservoir, it was found impossible to maintain pressure in the higher parts of the camps immediately after the noon mess hour daily when the mess kits were being cleaned, and for the greater part of Wednesday and Saturday afternoon when there was no drill, and when most of the showers in the camp could be found running either for bathing or washing purposes.

These difficulties were especially great during the period August 19th to September 11th, when the booster station was pumping into a closed system, not only without storage but without adequate pressure relief. During this period a direct telephone connection was maintained between the booster pumping station and the engineering office at the camp and during certain portions of the day, an observer was stationed at each point watching the pressure gages, the observer at the camp directing the operation of the suction valve on the pump so as to control the pressure at the camp. Even in spite of this precaution on several occasions sudden pressure jumps occurred, and breaks in the supply main resulted once or twice.

Standpipe Pressure Regulator

On September 11th a pressure regulating standpipe of 10 in. pipe supported by a wooden scaffolding was constructed and carried up to the elevation of the distributing reservoir, (then under construction). At the top of this standpipe an elbow and a 6-in. valve were leaded in, and this overflow at the highest point of the system proved a reasonably effective pressure regulator, although at times some attention to the pressure gage at the camp and control by regulation of the suction valves at the booster station were necessary.

In some respects there was much similarity between the cantonment water supply work and the work upon which the writer was subsequently engaged in the Water Supply Division of the Office of the Director of Construction and Forestry of the American Expeditionary Forces in France. In both cases the time element was of far greater importance than the ordinary considerations controlling engineering design. In one respect, however, the cantonment construction work was very much more satisfactory and enjoyable than that in France. Reference is made to the availability and orderly rapid delivery of material made possible by the efficient co-operation of the Washington office, as compared with the discouraging impossibility of securing materials which resulted from the tonnage shortage during the early days of the history of the American Expeditionary Forces.

The water supply work at Camp McClellan was carried on under the direction of the writer (who was succeeded, upon his departure for France by Mr. A. B. Hargis) first by Prof. G. J. Jacobs, of the University of Alabama and later by Mr. Ellwood Avery, as Division Engineer in charge of Water Supply; and under the supervision of Lieut. Col. (then Major) Dabney H. Maury, of the Engineering Division of the Department of Cantonment Construction at Washington; while on all construction work at the camp, the Supervising Engineer reported to Col. (then Major) Charles L. Dulin, Q. M. C., Constructing Quartermaster.

Experience with Metalium Joints in Water Pipe Lines in Davenport, Ia.

By Thomas Healy, Davenport Water Co., Davenport, Ia.

At the Council Bluffs meeting of the Iowa Section of the American Water Works Association a paper was read and there was discussion of a material used by the Omaha water works in the place of lead for making joints in the laying of water mains. It is called metalium. Afterwards we were taken to Omaha where we saw some joints poured with metalium and the water pressure was immediately thereafter turned into the mains having joints of this material.

Advantages of Metalium

The advantages in metalium joints seemed to be that the material was cheaper per joint than lead. Not so much fuel was needed to melt the material as needed to melt lead. The bell holes required were not so large and all caulking was dispensed with.

The disadvantage seemed to be, at that time, that greater care was necessary to melt the material because if too cold it would not pour and if too hot it became stiff and might burn. We saw no way by which a joint which leaked could be made tight and we did not have the nerve to act on the advice of the users who said let it alone and the leak will stop of itself. We had no previous acquaintance with that kind of a leak.

Metalium Successfully Employed

So when, as the war went on, and the cost of lead went up and the Government continued to request that metals should not be used, and everything was out of kilter anyway, we decided to try out metalium for joints in some mains we were laying for the U. S. Housing Corporation. This corporation was building several hundred houses to help relieve the situation caused by bringing several thousand additional families to Davenport, Rock Island and Moline, to help turn out material of war at the Government Arsenal situated at this point. These mains were required at once and we found we could lay them quicker when no caulking was required.

Procedure in Using Metalium

We usually join three or four lengths of pipe before lowering them in the trench. The pipe are laid on sticks across the ditch, lined up and leveled and after pouring are lowered by two pipe derricks using rope slings. No trouble seemed to result from handling the pipe after the joints were poured.

The metalium joint takes a little longer to cool than lead, especially the gate, which is made large to insure the filling of the joint.

We started out cautiously. We used the special furnace furnished by the metalium manufacturers and all the tools they have developed. We arranged with the manufacturers to send an expert to oversee the pouring of the first joints, but we started before he arrived and his only duty was to tell us that we had done the work well. Some of the pipe to lay was 12 in. and we used lead for this size. The first line using metalium was 6 in. pipe and this line was bottle tight when tested. The next 6 in. pipe laid developed two or three leaks and we decided that these leaks were due to carelessness, for the pouring seemed so easy the men neglected to clean the pipe in the joints or to make the gates high enough to insure a full joint. As soon, however, as we became as careful as we were when we began we had no further trouble.

We usually use 9 or 10 lbs. of lead in pouring a 6 in. joint and we found that 3 lbs. of metalium would make a joint of the same size. At that time lead was 8c and metalium 10c per pound so the material in the joint cost us about three eighths as much as lead would have cost. Lead, however, is much cheaper now than it was at that time.

When using lead we use a kerosene oil furnace which requires about 25 gals. of oil to keep it going all day. The number of joints poured in a day varies widely so the cost of oil varies, as it is not practical to let the lead furnace cool off, but the flame is kept going whether little or much lead is melted. With the furnace used for metalium we use only wood and we manage to "borrow" a piece here and there which furnishes the small quantity required.

It is evident that there being no work to do in the bell hole except to put on and take off the jointer very little space is required. We found at first that jointers were used up rather rapidly and probably there will be required more jointers than are required for lead. However, we now soak the jointer in water and smear it with clay and it lasts longer than formerly.

Metalium is easy to handle and we have had no trouble in getting our orders filled promptly. In one or two instances we have poured old joints that have caused trouble by lead blowing out and these joints hold well so far.

In 1918 we laid 9,155 ft. of pipe with metalium joints and we have so far laid nearly as much in 1919 and shall continue to use it until something better develops.

Leadite

In 1917 we laid 424 ft. of 6 in. pipe with "leadite" joints and this has given no trouble of any kind since laying. The method and cost of using leadite is not very different than in the case of metalium.

The foregoing paper was presented at the recent annual meeting of the Iowa section of the American Water Works Association.

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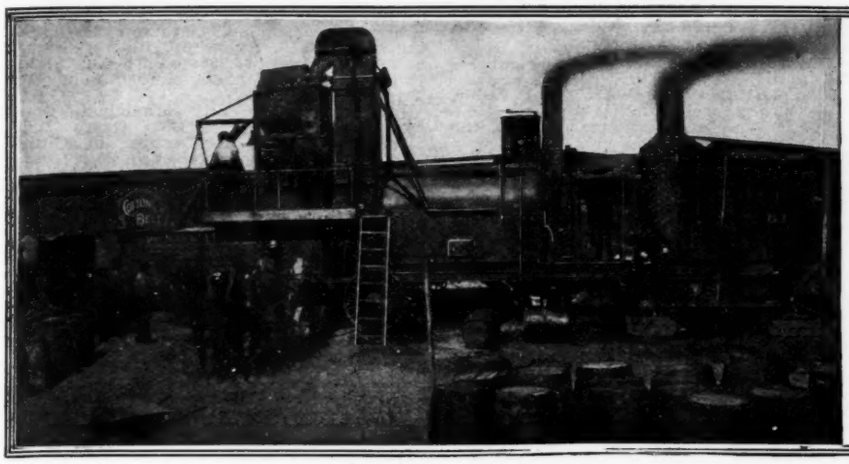

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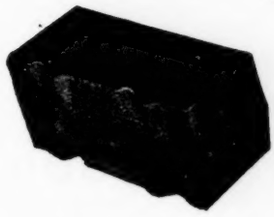

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SPRINGFIELD, ILLINOIS

CONTRACTS AWARDED

ROADS AND STREETS

Ala., Bessemer—H. N. Bowdry, Empire Bldg., Birmingham, awarded contract to pave 8 blocks of 19th street; granite-asph.; 5-in. conc. base, at $73,000.

Ark., Pine Bluff—W. P. McGeorge & T. A. McNulty awarded contract for paving with macadam the road 7 7-10 miles long—Gould to Douglas—at $100,000.

Cal., Santa Barbara—Fairchild-Gilmore-Wilton Co., Pacific Electric Bldg., Los Angeles, awarded contract for paving West Montecito street and Cliff Drive, at $61,008.

Cal., Santa Barbara—Fairchild-Gilmore-Wilton Co., Pacific Electric Bldg., Los Angeles, awarded contract for impvt. of Montecito street—State to Milpas street—at $49,630.

Cal., Sacramento—State Hwy. Comn. awarded following contracts: J. A. Marshall and J. S. Baker, Berkeley, for bldg. 3 miles, Div. 4, Route 5, Sect. A, State Hwy. betw. Glenwood and Sand Hill School, Santa Cruz Co.; F. Rolandi, 550 Montgomery St., San Francisco, 11 miles, Div. 11, Route 20, Sect. E, State Hwy. betw. White Bar creek and Helena, Trinity Co.

Cal., San Francisco—Blanchard, Crocker & Howell awarded contract by Bd. of Works, for paving of Great Hwy., betw. Esplande and Sloat Blvd., at $79,777.

Conn., Bridgeport—Warren Bros Co., 193 Berkeley St., awarded contract by city for paving various streets at about $600,000.

D. C., Washington—Cramford Paving Co., Washington, awerded contract by Government for approx. 12 miles of conc. paving, 18-ft. wide, on portion of main rd., betw. Morrison and Lee Hall, at $417,600.

D. C., Washington—Cramford Paving Co., 2620 E. Stl, N. W., Washington, D. C., awarded contract for asphalt paving (abt. 13,000 sq. yds.) at $65,000.

Fla., Petersburg—J. W. Talley awarded contract for laying concrete on Union and Fleet streets at $11,779. Perkinson & Flinn, awarded contract for laying Lake Sheet asph. over concrete on Hallifax street at $32,524, and for laying Lake Sheet asph. over conc. on Wythe and Main streets at $66,182.

Fla., West Palm Beach—Bryan & Snyder Co., Fort Lauderdale, awarded contract by Palm Beach Co. Commrs. for constr. of 16½ miles, grading and hard-surface rock road on bank at Palm Beach Canal to Lake Okeechobee, at $129,975.

Id., Boise—Morrison & Knudsen awarded contract for 23 mi. of Star-McCall Hwy.—Banks to Smith's Ferry, at approx. $140,000.

Ill., Belvidere—Standard Paving Co., 326 West Madison St., Chicago, awarded contract by Lake Co. for paving 53,760 sq. yds. Belvidete Rd., Sect. G-15d (without cement), at $99,610.

Ia., Marshalltown—P. E. Shugart, Nevada, awarded contract for widening entire hwy.—approx. 2½ miles; grading entire hwy., bet. Le Grand and Gilman, and grading new rdway. west of Le Grand, at 41c per cu. yd. Total approx. cost abt. $42,000.

Ill., Moline—J. J. Donegan awarded contract for paving Lincoln Hwy. through Whiteside county—14 miles, 16-ft. wide—at $280,000.

Ill., Paris—Following contracts awarded by Co. Supt. of Roads: Grable & Webright, Martinsville Rd., at $12,408; Jos. Connery and Jno. Cline, Conlogue Rd., at $18,408; Connery & Cline, Kimes Rd., at $11,875; also Clarksville Rd., at $9,845; Connery & Athey, Wetzel Rd., at $16,818.

Ill., Peoria—Jansen & Schaefer, Pekin, Ill., awarded contract for section of Springfield-Peoria Rd. (abt. 6½ miles) beginning at end of Second street and extending south, at $137,000.

Ill., Springfield—Contracts awarded as follows by Division of Hwys: Chicago Heights Coal Co., Chicago Heights, awarded contract for several sections of Dixie Hwy., in Will Co., at $252,800; Jas. O. Heyworth, Chicago, several sections of National Hwy., Clark Co., at $526,585; J. W. Etchison, Casey, contr. for several sects. in Clark and Cumberland counties, at $304,780; Jas. O. Heyworth also secured a sect. in Cumberland county at $124,412; H. W. Hays & Sons, Janesville, Wis., two sects. in Cumberland county at $294,553. Total amt. of contracts, approximately $1,500,000.

Ill., Springfield—Keokuk Quarry & Construction Co., Keokuk, Iowa, awarded contract to construct alst sections of Lincoln Hwy., bet. Chicago and Fulton, Ill., at $121,000. Contract is for sections 15-d and 12, each extending two & three-quarter miles out from Franklin, Lee Co.; one to the east and the other to the west.

Ill., Springfield—Stipes & Pilcher, Urbana and Champaign, awarded contrs. for constructing section K, Route 2 and section L, Route 5, state aid roads, Champaign county at $39,770. Sect. K (brk.), extends 3,440 ft., from pavement now built out of Urbana on Cunningham avenue, for more than 1 mi.; Sect. L, Route 5, extends southward from Savoy Rd., paving out of Champaign for 5,552 ft. and extends (brk.) pavement of Egyptian trail almost to Savoy—5 mi. out of Champaign.

Ill., Springfield—Nelch & Son awarded contract to construct Sangamon Division of Springfield-Peoria Road, at $143,000.

Ind., Anderson—Daniels & Lyst awarded contract for bldg. Brattain cem. Rd., Fallcreek Twp., at $71,285.

Ind., Auburn—Chas North, Columbia City, Ind., awarded contract for constructing a gravel and a gravel and stone road in Wilmington Twp., at $28,450.

Ind., Columbus—Premier Construction Co. awarded contr. for Nentrup Rd., at $68,000.

Ind., Kokomo—Following contracts awarded by County Auditor: Schuyler Kelley, Windfall, Ind., contr. for constructing gravel road, Union and Liberty Twps., at $10,240 and $5,398; Chas. J. Stahl, Kokomo, contr. for gravel road in Taylor Twp., at $4,598.

Ind., Michigan City—Municipal Contracting and Supply Co., Gary, Ind., awarded contract for impvt. of Grand Beach Road and park road in city. Two roads are known as the Bartholomew and Carow roads. Contract price on Bartholomew Rd. is $8,494; on Carow Rd., $35,580.

Ind., Shelbyville—Following contracts awarded by Shelby Co. Board: Pat Shahan, Frankfort, Ind., awarded contract for the Weintraut Rd. at $16,828; Haymond & Howard, Waldron, Ind., contr. for Linnville Rd. at $28,200; Ellaha Sexton, Shelbyville, for impvt. of Dobbins Rd. at $15,706.

Ind., South Bend—Western Constr. Co. awarded contract for impvt. of Sherman avenue—Lincoln Way west to Portage avenue, with asph.-concrete, at $24,373.

Ind., Warsaw—E. G. Gast, Warsaw, awarded contract for constr. of Leesburg road from end of pavement on No. Detroit street in Warsaw to Wayne Twp. line—abt. 1 mile—at $18,895.

Ia., Emmetsburg—Hanlon & Oakes, Minneapolis, awarded contract for paving to be done this summer in Worthington, Minn., at $315,000.

La., Hedrick—Leckliter Davis Co., Corning, Ia., awarded contract for grading, curbing and guttering and paving 23 blocks, abt. 2 miles of streets, at $58,000.

Ia., Onawa—Western Asphalt Paving Co., Sioux City, Ia., awarded general contract ofr paving at $120,000.

Kans., Atchinson—Al. Schmeling awarded contract to repave S. Fifth street, from Commercial to U streets (nine blocks), at $75,977.

Kans., Harper City—A. L. Cook, Ottawa, awarded contract for paving of Main and Central avenues at $200,000; 52,600 sq. yds. of paving on streets.

Kans., Larned—Wheeler & Kelcher, Hutchinson, awarded contract for paving about 5 miles on Santa Fe trail—Hutchinson to a mile No. of Yaggy; Stamey-Mackey Construction Co. awarded contract for paving 5½ miles on Trail from Yaggy to Nickerson, at $89,951 and $100,823, respectively.

Ky., Lexington—J. H. Cahill, Lexington, awarded contract to constr. 10 miles Lexington-Winchester Pike at $285,887.

Ky., Mt. Vernon—E. A. Chilton, London, Ky., awarded contract to constr. 7 miles graded earth road on Eastern Dixie Hwy., Rockcastle Co., at $81,594.

La., New Orleans—Southern Bithulithic Co., City, awarded contract for constr. of 1.6 miles bitum. macadam hwy., branching out from the Alexandria Camp Beauregard Rd. to the U. S. Reconstruction Base Hospital, at $60,000.

La., Shreveport—J. M. Montgomery awarded contract for paving Greenwood Rd., Queensborough—Stonewall to Green-

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wood Rd., at 53c per cu. yd. There are approx. 7,500 cu. yds. of dirt to be removed.

Mass., Pittsfield—D. J. Walsh, 311 North St., awarded contract for paving South street—Bank Row to S. Mountain Rd., at $136,000; Pecks Rd.—Mahconah street to Highland avenue, to Lane Construction Co., 37 Colony St., Meriden, Conn., at $35,000; bldg. appurts. and paving W. Housatonic street—Center to Hawthorne streets, to Lindholm and Piscatelli, Pittsfield, at $44,000.

Md., Baltimore—Union Paving Co., 119 Lafayette St., Schenectady, N. Y., awarded contr. to pave 1.18 mi. of Monroe street—Eagle to Mosher streets(sheet asph. on 6-in. conc. base, at $100,622.

Md., Cambridge—Hilton Construction Co., Denton, Md., awarded contract to construct 2.15 miles road from end of Contract D-19, near Madison, to beginning of Contract 466 at Parsons creek, at $59,979.

Md., Cumberland—K. C. Constr. Co. awarded contract to pave 5 streete with wood block, concrete and brick; Cumberland Contracting Co. contr. to pave section of Green street, with brick, at $26,907 and $81,720, respectively.

Md., Cumberland—R. G. Collins, Jr., 820 Munsey Bldg., Baltimore, awarded contract for bldg. 4½ miles concrete road from city limits to site of Am. Cellulose & Chem Mfg. Co., at $236,628.

Md., Denton—Peninsula Constr. Co., Berlin, Md., awarded contract to construct 2.5 mi. of road from Grove to Bureau, Caroline county, 15-ft. width, at $79,456.

Md., Elkton—E. W. Brown, Port Deposit, Md., awarded contract to surface with concrete sections of gravel road betw. North East and Elkton, Cecil Co.,—1.38 miles—at $36,608.

Md., Towson—American Paving and Contracting Co., Montebelloe Ave. and Jenkins Lane, Baltimore, awarded contract to construct .93 miles conc. road through Reisterstown, Baltimore Co., at $76,989; to construct 2.7 mi. Baltimore-Washington Blvd.—from new city limits of Baltimore to near Relay, sheet asph. on existing conc, base, at $49,960.

Mass., Boston—Coleman Bros., Chelsea, Mass., awarded contract for paving 2,900 ft. Drydock avenue, 70 ft. wide, at $149,103.

Mass., Boston—Rowe Contracting Co. awarded contract for Topeka pavement in Centre street—Eliot street across Allandale street, at $45,573; Central Construction Co. contr. for Topeka pavement in Greenwich, Newbern, Sussex, Weston, Windsor and Williams streets, at $51,178.

Mass., Pittsfield—Lindholm & Piscatelli, Pittsfield, awarded contract for paving Hurlburt, Union, Tyler and North streets, at about $26,000.

Minn., Chisholm—Abbey & Maturi, Chisholm, awarded contract for little over 2 miles of conc. paving on Chisholm-Hibbing Rd., at approx. $50,000.

Minn., Duluth—D. H. Clough & Co. awarded contract for bithu. paving on E. First street, betw. 6th and 23rd avenues, at $105,932; Jno. McDonnell, contract for paving 14th street—9th to 10th streets, at $6,500; A. N. Nelson awarded contract for paving 12th avenue—9th to 12th streets, at $8,527; Nels Andeson awarded contract for laying tile and cem. walks on 12th street, W., at $10.834; August A. Bodine & Son awarded contract for laying walks west side of 12th avenue, W., at $10,275 and also for paving 65th alley—W. from Ramsey to Bristol streets—at $2,383.

Minn., Duluth—D. H. Clough & Co. awarded contract for impvt. of 26th avenue—E. First street to Eighth street—at $36,941.

Minn., Duluth—A. N. Nelson awarded contract for impvt. of thir alley bet. 21st and 22nd avenue, W., at $2,031; C. R. McLean contract for paving Winona avenue—Woodlawn to Ewing avenues, at $10,-236; D. H. Clough & Co. contr. for paving 26th avenue, E., from 1st to 8th streets, at $36,841.

Minn., Minneapolis—General Contracting Co. awarded general contract for hard-surface paving on Lyndale avenue road from city limits to Fort Snelling-Shakopee road near Minnesota river—5½ miles distant, at $192,848. General Contracting Co., 1254 Plymouth Bldg., Minneapolis.

Minn., St. Paul—Fielding & Shepley awarded contract for paving E. 6th street—bridge to Arcade street—at $48,245; Thornton Brothers, contr. for impvt. of Concord—Ada to Annapolis streets—at $71,400.

Minn., Red Wing—Grant-Smith Co., awarded contract for paving Main street—Broadway, westerly to the Alexander P. Anderson farm, at $167,748.

Minn., Stillwater—Jamieson, Thorsen & Sandeen, awarded general contract by Co. Commrs., to construct State Rd. No. 3—Boom Coulee to other side of Marine-on-St. Croix, at $66,888.

Minn., Superior—Magnus Peterson, Superior, awarded contract for paving Oakes avenue, at $44,875; Ed. Johnson & Sons, awarded contract for paving Banks avenue, at $18,955; also contr. for paving Becker avenue—W. 5th to W. 6th streets, at $5,025.

Mich., Grand Rapids—Vander Weele Bros., awarded contract for paving Madison avenue, brk., bet. the tracks, bet. Cramford and Burton streets, at $58,619; Jas. B. Hoey, awarded contract for grading and paving 5th street with concrete bet. Broadway and Davis avenues, at $12,270.

Mich., Grand Rapids—Boyes & Blandford, City, awarded contract for construction of 3 miles of concrete roadway north of city limits on Alpine road at $59,850.

Mich., Grosse Pointe Farms—Moran Construction Co., City, awarded contract for paving one side of Grosse Pointe Blvd., at $75,000.

Mich., Lansing—Wolverine Construction Co., Kalamazoo, Mich., awarded contract for approx. 7 miles of road to be known as Federal Aid Road No. 30, on Dowagiac-Niles Road, at $167,751.

Miss., Jackson—J. N. McLeod, Jackson, awarded contract by Hinds county to construct 4 mi. gravel rd., betw. Natchez and Jackson, at $32,500.

Mo., Kansas City—E. D. Tyner Constr. Co., awarded contract to reconstruct asphalt pavement on Grand avenue—15th to 20th street—at $42,755.

Mo., Kansas City—E. B. Stewart awarded contract to widen and grade Bamore avenue—14th street to Southwest Blvd., at $18,465.

Mont., Missoula—Carlson-Norman Co. awarded contract for construction of stand. hwy.—Kooskia to Lowell, Idaho, at $153,-347. Hwy. will be 28.8 miles in length.

Mont., Missoula—Carlson-Norman Co., Spokane, awarded contract for constr. of 35 miles of public hwy. along north fork of Flathead river at $125,000. Hwy. will run along west side of Glacier National Park, leaving main hwy. at Columbia Falls and going to the Canadian border.

Neb., Columbus—E. Peterson Co., 1217 Woodmen of World Bldg., Omaha, awarded contract by Platte and Madison Cos., for grading 232,000 yds. Fed. Aid road from here to Norfolk via Platte Center and Humphrey, at $85,840; also contract by Cass and Otoe counties for grading 144,000 yds., from Plattsmouth to Nebraska City, at $55,440.

Neb., Lexington—National Roofing Co., Omaha, awarded contract for 10 blocks of paving in Albion (asph. and conc.) at $1.78 a yd.

Neb., Lincoln—Lammereaux Bros., Omaha, awarded contract for construction work on Fremont-Ceresco state highway project, abt. 30.33 miles long, at $53,000; Edward Peterson, awarded contract for 37.68 miles of state highway, bet. Schuyler and Osceola, by way of David City, at about $100,000.

Neb., Nebraska City—Capital Bridge Co., Lincoln, awarded contract for concrete work in Division 2, Cass county, grading (144,000 cu. yds.) contract to Fred Peterson, Omaha, at 38½c per cu. yd.

Neb., Wahoo—Allied Construction Co., 420 Peters Trust Bldg., Omaha, awarded general contract for 40 blocks of paving at $3.48 per yd.

N. J., Atlantic City—Sutton and Corson, Ocean City, awarded contract for paving Mays Landing and Pleasantville ends of road connecting them, at $213,747. Total dist. to be improved with Warranette top surf. on conc. fdn., is 3½ miles.

N. J., Burlington—Union Paving Co., Philadelphia, awarded contract for paving sheet asphalt rdways. on conc., from Mount Holly to Moorestown, at $2,010, and from Palmyra to Broad street, Beverly, at $133,634.

N. J., Newark—Northern Construction Co., awarded contract for paving Grove street—Central avenue in East Orange to the Newark-Irvington line, at $60,761.

N. Y., Brooklyn—Sicilian Asphalt Paving Co., 41 Park Row, N. Y. City, awarded contract for regulating, grading, curbing & laying walks on Dumont avenue at $3,819; E. 4th street, $15,404; E. 17th street, $13,-785; Grimm Constr. Co., 460 Harold Ave., Richmond Hill, E. 4th street—From avenues I to J, and excavating to subgrade of 9 in. avenue I—East 3rd to East 4th street, at $4,488; Brooklyn Alcatraz Asphalt Co., 409 Hamburg Ave., East 67th street, at $9,785.

N. Y., Patchogue, L. i.—L. S. Fulton, Elmhurst, awarded contract to pave with conc. North Ocean avenue—Lake street to village limits and Oak street No. Ocean avenue to Maple avenue, at $29,160.

N. C., Albermarle—Gibson Construction Co., Knoxville, Tenn., awarded contr. to construct topsoil surf. road to county line west of here, toward Charlotte—21 miles; also topsoil surf. road from here toward Wadesboro to Rocky river—14 miles.

N. C., Durham—R. G. Lassiter, Oxford, N. C., awarded contract to construct highway, at about $300,000.

N. C., Statesville—Thompson-Caldwell Construction Co., Charlotte, N. C., awarded contract to construct 48,000 sq. yds. asphaltic concrete pavement, 48,000 sq. yds. sheet asph. pavement and 10,000 sq. yds. cement concrete pavement, at $328,000.

O., Ashland—V. H. Au & Son, awarded contract for improvement of Ganges-Plymouth road, Richland Co., at $52,195; road will be of tarbound macadam and is 2½ mi. long; awarded contract for concrete road in Richland county, at $38,759. Fred Gandert & Son, Mansfield, O.

O., Bradford—Andrews Asphalt Co., Hamilton, awarded contract by village for impvt. of Main and Miami streets. Sheet asphalt will be used and entire improvement will cost about $100,000. Work includes bldg. sanitary and storm sewers, constructing curbs and gutters; curbing in bus. sect. will be sandstone and in residence dist. concrete.

O., Bryant—C. W. Fuelling, Ft. Wayne, awarded contract for conc. paving on abt. 4 mi. Pelier-Jimtown road No. of Montpelier, at $76,379.

O., Pauliding—Following contracts awarded for pike road jobs: Dotterer-Upthegrove Pike, to J. S. Blosser, at $59,633 (4.73 miles); W. D. Price Pike, (2.02 mi.) to Don Roach, at $19,361; Lucas-Dangler Pike, (7 mi.) to Don Roach, at $59,139, and David Ringer Pike, (1.9 mi.) to Soi Putman, at $16,951.

O., St. Marys—Ball & Cook, Dayton, awarded contract for constr. of Wapakoneta-St. Marys intercounty hwy. No. 165—6.52 miles—at $170,288.

O., Youngstown—Henderson Construction Co., awarded contract for retaining wall—extending from the Himrod avenue brdg. on both sides on street as far as Watt street—at $108,642.

Okla., Tulsa—Tulsa County Commrs. let contract to Jos. T. Lantry Constr. Co., to pave 19 mi. of highway, Tulsa-Owasse road, 5 mi. section between Broken Arrow and Tulsa-Bixby road, and road from Rose Hill Cemetery to Dawson, at $438,710.

Ore., Portland—Baker Bros., 626 Bd. of Trade Bldg., awarded contract for grading Greelet street extension known as New St. Johns road, at $105,576.

S. C., Columbia—Powell Contracting Co., Columbia, awarded contract to pave Assembly street—Gervais to Taylor—with cement conc.; 17,000 sq. yds paving; 5,000 ft. curbing, at $53,000.

Utah, Salt Lake City—Heiselt Constr. Co., Salt Lake City, awarded contract for constr. of Heber-Fruitland Rd., Utah, (abt. 20 miles) at approx. $70,000.

Utah, Salt Lake City—State Road Comn. awarded following contracts for 33.18 mi. of conc. hwy.: 4.85 miles to Alston & Hogan, at $115,553, also 8.23 miles at $194,-454; Wattis & Samuels, contr. for 11.12 mi., at $294,495, and F. E. Phelps, contr. for 8.98 miles at $75,540.

Va., Winchester—Betts & Boyce, Harrisonburg, Va., awarded contract to constr. road from Winchester to Opequon, on Boyce road, at $88,000.

Wash., Seattle—Seaboard Construction Co., Seaboard Bldg., awarded contract by Bd. of Commrs., King Co., for paving the J. B. McDougal Rd. and extension running from a point of the Des Moines Rd. near Sunnydale to end of Lake Burien car line; 1.87 miles of concrete rdway., 16 ft. wide, at $47,904.

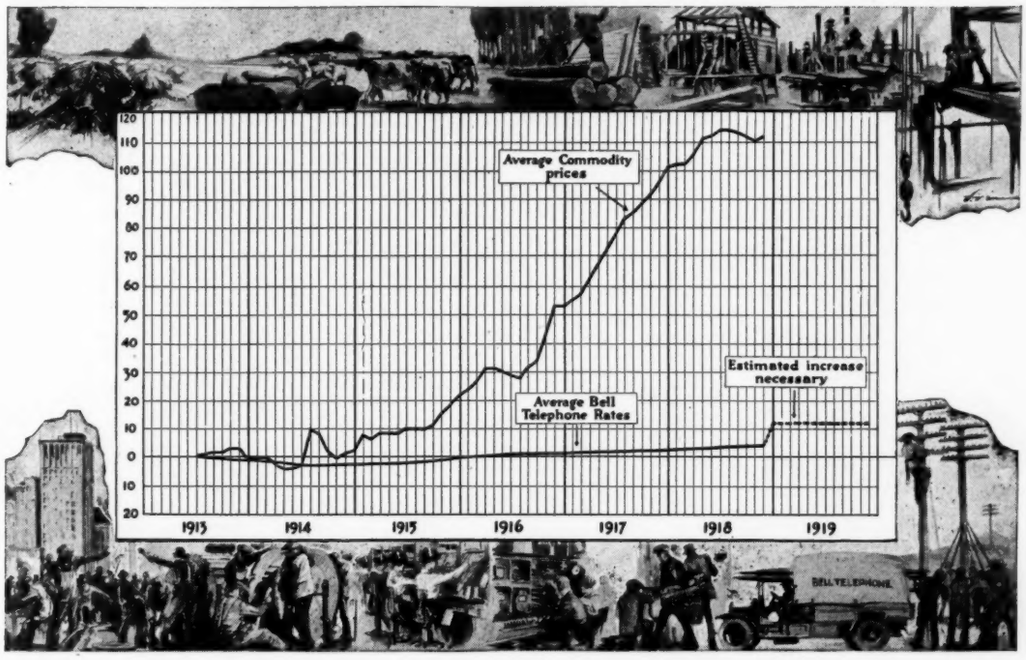
W. Va., Elkins—Hennig & Hegerdon, Charleston, awarded contract to surface 8.65 miles Surveyor-Marshes, Harper and Guyandotte roads, at $100,000.

Wis., Grand Rapids—Fred Bossert, Grand Rapids, awarded contract for grading, culverts and conc. surfacing on Grand Rapids-Plover road, at $60,248.

Wis., Kenosha—F. W. Whitlow (former county hwy. commr.) awarded contract to construct concrete roads in Kenosha Co., at $72,000. Roads include following: 1 mi. in Somers near station; Geneva Rd. in Bristol for 7,000 yds.; stretch of Sheridan Rd. inn Pleasant Prairie, etc.

Wis., Janesville—C. F. Perry, Brodhead, awarded general contract by town of Spring Valley, for grading and broken rock macadam on Brodhead-Evansville road, at $3,402; Wm. McGavock, Beloit, awarded general contract for grading and gravel macadam on Milwaukee road, at $2,752.

Wis., Ladysmith—Jas. F. Mitchell, Ladysmith, awarded contract for Prentice-Ladysmith road, at total cost of $22,813.



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A graphic picture of the high cost of doing business is shown by the rise in a long list of commodity prices during the past five strenuous years.

By the exercise of unparalleled economies, telephone rates have been kept almost unchanged.

The fact is, the increase in the cost of commodities has resulted in what is equal to a decrease in telephone rates. In other words: The dollar which was spent for the telephone has bought more than twice as much as the dollar spent for the commodity.

The activities of reconstruction which are now upon the nation have put a great burden upon the telephone. This condition has made necessary an advance in telephone rates.

This advance does not exceed an average of eight percent; almost negligible as compared with the advances in other lines of industry, yet enough to cover the increase in the cost of operation.

Only through adequate revenue can there be assured the maintenance of a high standard of telephone service.

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Work includes grading, conc, culverts, conc. bridges, etc., etc.

Wis., Milwaukee — Milwaukee General Constr. Co., 857 8th Ave., Milwaukee, awarded contract for Howell road No. 4; grading, conc. culverts, conc. paving, at total cost of $53,308. R. H. Gumz, 831 13th Ave., Milwaukee, awarded contract for impvt. of Greenfield avenue No. 3; grading, conc. culverts, reinf. conc. brdgs. and conc. paving, at total cost of $26,703.

Wis., Racine—L. L. Tindall, Waterford, awarded general contract for Racine-Rochester road, Racine Co., town of Dover, at $36,486.

SEWERAGE AND SEWAGE TREATMENT.

Ariz., Flagstaff—McLean & Walsh, El Segundo, awarded contract for bldg. sewerage system, using cement pipe, at $82,396.

Cal., Los Angeles—Miagenovich & Gillespie, awarded contract for constr. of cement pipe sewer in La Cretsa Court, at $1,093, contract for constr. of clay pipe sanitary sewer in Mettler street and contract for cement pipe sewer in St. Andrews Pl., at $1,473.

Cal., Los Angeles—Miagenovich & Gillespie, awarded contract for constr. of cement pipe sewer in 54th street, at $1.097.

Cal., Fresno—H. Gould, Sacramento, awarded contract for constr. of sewer system in No. Fresno district, covering two contracts, at $107,136.

Cal., Long Beach—P. P. Janich, awarded contract for constr. of vitr. pipe sewer in Loma Vista Drive, at $6,248.

Cal., San Bernardino—Chas. McElvaine, awarded contract for constr. of an 8-in. vitr. pipe sanitary sewer in Second street—K to Mt. Vernon avenue, one flush tank, two manholes and 13 connecting sewers at 58c per lin, ft. for 8-in. sewer, 40c per lin. ft. for connecting sewers, $50 each for manholes and $70 for flush tank.

Ill., Chicago — Following contracts awarded for drains in various streets: Louis Scully, Warrant No. 46876; Nash Di Domenico, Nos. 46877 and 46881; Angelo Santucci, Nos., 46878 and 46880; Giacomo Sironi, Nos. 46458 and 46460; Jno. Tiritilli, Nos. 46883 (sys. of streets) and 46879.

Ill., Chicago—Contracts for bldg Des Plaines river sewerage treatment works awarded as follows: Div. A, Leyden-Ortseifen Co., 53 West Jackson Blvd., at $384,281; Div. P to W. A. Jackson Co., 37 W. Van Buren St., at $22,705; Div. W, to Builders' Iron Fdry., 209 S. La Salle St., at $12,760.

Ill., Danville—J. W. Stokes, awarded contract for garbage incinerating plant at $17,500.

Ind. Ft. Wayne—Anton Rieg, awarded contract for constr. of local sewer No. 298, at $2.30 per lin. ft.

Ind., South Bend — L. H. Webster, awarded contract for installation of pipe sewer on Haney avenue—second alley east of Marine to Leer street and on Linden avenue—Meade to Olive streets.

Ia., Dyersville—Jno. Kriebs, Dyersville, Ia., awarded contract for lateral sewers on Allen street, Main street, Chestnut street; in alleys bet. Clarence and Bethel streets to Grove and Clarence streets, at $4,062.

Ia., Estherville—Hammen Kruse & Co., Spencer, awarded contract for sewer work in connection with 3 miles of paving work let to Des Moines Asphalt Paving Co.

Ia., Garner—Cook & Kean, Dubuque, Ia., awarded contract for outlet and lateral sewers here at $592,141; H. A. Teget, Webster City, Ia., contract for disposal plant at $14,182.

Ia., Humboldt—Carl Johnson, awarded contract for storm sewer—beginning at Saul Studio corner and connecting with the tile of District No. 13; Humboldt Gravel & Tile Co., contract for tile.

Ia., Rock Valley—R. L. Cox, Webster City, awarded contract for sanitary sewer at $55,750; R. C. Digel, Webster City, contract for disposal plant.

Ia., Roland,—O. N. Anderson, Roland, awarded contract for constr. of new sanitary sewer here at $47,000.

Ia., Sioux City — Jno. Grubbs, Local, awarded contract for sewers on W. 14th street at $1.11.

Ia., Tama—Dearborn Construction Co., Waterloo Savings Bank Bldg., Waterloo, awarded general contract for sewer—8 blocks. Tile, 600 ft. 15-in., 11,900 ft. 12-in., 3,185 ft. 10-in., also 57 spcl. and 108 stand. catchbasins and 63 manholes.

Kans., Eureka—J. S. Davis, Eureka, awarded contract for constructing lateral sewer No. 30, at $1,892.

Me., Portland—Lorello & Profenno, 255 Capisic St., awarded contr. for constructing Saunders street overflow sewer at $11,734.

Mass., Boston—A. Baruffaldi, awarded contract for sewerage wks. in Elton street at $2,625. Following also awarded contracts for sewerage works in various streets: J. A. Costello & Co., at $35,479; Jas. J. Coughlan Co., at $38,236; Timothy Coughlin, at $545.50; Geo. J. Regan, at $1,777.

Mass., Boston—Jos. Todesca, awarded contract for sewerage works in Billings streets, betw. Spring and Hamilton streets, West Roxbury, at $3,618; Bianco Parenti Co., awarded contract for sewerage works in North street, betw. Harris and Hanover, at $1,549.

Mass., Boston—J. W. O'Connell, awarded contract for sewerage works in alley No. 451, at $9,261.

Mass., Boston—D. Vitiello, awarded contract for sewerage works in Redlands road, betw. Centre and Abbott streets, West Roxbury, at $4,607; Michael H. Loonie, contract for sewerage works in Green street—Amory to Washington streets, West Roxbury, at $2,450.

Mass., Fall River—Sewer Committee voted to recommend adoption of two orders for sewer construction as follows: High street—Bedford northerly 220 ft., to amt. of $4,000; Buckley street—present terminus northerly to Elizabeth street, $5,500.

Mass., Reading—Metropolitan Water & Sewer Bd., Ashburton Pl., Boston, authorized to build outlet sewer to connect city system with metropolitan system. Abt. $280,000. A. O. Doane, 1 Ashburton Pl., Boston, Engr.

Mass., Springfield—City has appropriated $50,000 for purpose of constructing new sewer in Carlisle Brook Sect. C. M. Slocum, City Engr.

Mass., West Roxbury — D. Vitiello, awarded contract for sewerage works in Greenview avenue and Warren square, at $3,420.

Mich., Dearborn—Brandon & Hanna Co., Detroit, awarded contract for constructing storm sewer here at $106,962.

Mich., Detroit — Walker & Teeteart, Penobscot Bldg., awarded contract for bldg. crock sewers in Frischkorns Tireman Park subdivision, at $26,499; J. Connelly Constr. Co., Dime Bank Bldg., awarded contract for Seven Mile Rd. sewer—Woodward to Yakima avenues, 4,781 ft. long, at $276,300; Walbridge-Aldinger Co., 2356 Penobscot Bldg., sections 1 and 2, Lonyo Rd. Pub. sewer, $1,430,000.

Mich., Detroit—Waldridge & Adlinger, Deroit, awarded contract for constructing Lonyo road public sewer in Lonyo road—Dix avenue to station 44; also sewer in Lonyo road—station 44 to So. line in Kirkwood avenue, at $1,430,000; Connolly Construction Co., Cleveland, O., awarded contract for 7-mile road public sewer in 7-mile road at $276,300.

Mich., Detroit—City let contracts to R. D. Baker, 1415 Penobscot Bldg., for bldg. lateral sewer No. 3062 at $3,666, No. 3116 at $10,201, No. 3117 at $3,693, No. 3118 at $3,574, No. 3123 at $2,100, No. 3126 at $8,800 and No. 3127 at $3,450; Western Constr. Co., 1208 Ford Bldg., No. 3119 at $3,467, No. 3125 at $9,242; W. Blanck & Co., 330 Longfellow Ave., No. 3120 $18,103, No. 3122 at $22,000; Walker & Teeteart, Windsor, Ont., No. 3124 at $1,170.

Mich., Ferndale—Contract awarded to a Milan, Mich., contracting firm by Ferndale Comn., for new sewer system, at $37,000.

Mich., Grand Rapids—Albert H. Prange, awarded contract for one mile of sewer construction in Milwaukee, Wis., at $150,000.

Mich., Pontiac—A. F. Kleist & Co., awarded contract for sanitary sewer in Perry street—end of pavement to Paddock street.

Mich., Pontiac—Pittsburgh Construction Co., Diamond Bank Bldg., Pittsburgh, Pa., awarded contract by city for bldg. sewage treament works involving 2,052 lin. ft. outfall sewer, grit chamber, 2-sty. settling tanks, etc., at $295,796.

Mich., Grand Rapids—City considering constr. of sewer in McReynolds avenue, Fourth street to a point near Fifth street, petition filed for sewer along Burton—Jefferson to Madison; estimates filed for sewer in Franklin bet. Giddings and Ethel avenues, $985; in Terrace avenue—Beulah to Griggs street, $780; in Lane avenue—Watson to 132 ft. no. of Dayton, $425.

Minn., Bemidji—Goodman & Loitved, local, awarded contract for storm sewers east of Beltrami avenue betw. 10th and 13th streets, at $7,115.

Minn., Biwabik—Lawrence & McCann, Eveleth, awarded general contract for constr. of storm sewer on First avenue, N., at $14,507.

Minn., Brainerd—Illstrup and Olson, 303 West 49th street, Minneapolis, awarded contract for sewers: D-8, F-2 and F-3; Sherlund Co., local, contract for F-1.

Minn., Duluth—Riback & Parvi, awarded contract for constr. of sanitary sewer, London Rd., betw. 20th and 21st avenues, E., at $701.00; Pastonet Construction Co., awarded contract for sewer system in the Norton-Fairmont Park division, at $44,-782; Johnson & Korhonen, awarded contract for sanitary sewer in 7th street, bet. 1st and 42nd avenue, W., at $1,075.

Minn., Duluth—Council has been petitioned to construct sanitary sewer in 103rd alley west from House street to Gary alley. W. H. Borgen, City Clk.

Minn., Farmington—Druar & Smith, 513 Globe Bldg., St. Paul, retained as engineers for street paving, sewers and water extensions. E. H. Dosey, Vil. Clk. Plans in progress.

Minn., Eveleth—Lawrence & McCann, City, awarded contract by Village of Leonidas for laying approx. 5,000 ft. sewer pipe.

Minn., Litchfield—E. Lenhardt, local, awarded contract for two miles of sewers, at $11,810.

Minn., Luverne—Sewers ordered constructed on Maple Cottage Grove Lincoln, Davison and Luverne streets.

Minn., Rochester—City has retained L. A. Bouley Co., Engrs., 120 Nicholas Bldg., Toledo, to make surveys and prepare plans for 12-15 mile sewerage system.

Minn., St. Paul—O'Neil & Preston, Juno and Edgecomb Roads, awarded contract for constructing sewer connections on Concord street, Earl street and Laurel avenue, E. 6th street and Arcade street, at $66 per each connection.

Minn., Walnut Grove—Druar & Smith, 513 Globe Bldg., St. Paul have been retained to draw plans and supervise constr. of sewers. D. A. Malloy, City Clk.

Miss., Greenville—City plans to improve its sewerage system and extend street paving. J. H. Weatherford, Engr., Memphis, Tenn., has made report showing that for $50,000, the sewerage sys. can be improved and enlarged to meet present demands.

Mo., Kansas City—M. Walsh & Son, awarded contract for bldg. sewer at $21,831.

Mo., Rockport—Katz Construction Co., 620 Brandeis Bldg., Omaha, awarded contract for bldg. sewers at about $20,000.

Mo., Springfield—Ralph Langston awarded contract to construct sewer in Seventh Ward at $22,131.

Mont., Anaconda—Petition signed by majority of voters in East Butte and McQueen Additions, presented to Bd. of County Commrs., asking for constr. of sewer project, which is estimated will cost abt. $18,000. According to estimates of surveyor, contemplated project will require 5,500 ft. 8-in. pipe and about 3,000 ft. 12-in. pipe.

Mont., Butte—City will construct lateral sewers on Duluth avenue, 21st to 22nd streets and on 10th street from Western avenue to Covell.

Mont., Butte—P. Stamson, 616 Neveda Ave., awarded contract for bldg. 4-in. segmental blk. storm sewer in Dakota street, at 5,409; rein. conc. storm sewer in Henry avenue, to G. L. Gagnon, 41 Owsley Blk., at 5,290.

Neb., Beatrice—Inter-Mountain Constr. Co., Tecumseh, awarded contract for constructing sanitary sewer in Dist. No. 31, at approx. 18,500.

Neb., Blair—$25,000 bonds voted by city for construction of sewers.

Neb., Columbus—City will construct storm sewers in District No. 3.

Neb., Crawford—City contemplates sewer construction in Blocks 16, 17 and 18.

Neb., Friend—City considering constr. of sewers and sewage disposal plant. Will vote on bonds soon. Est. cost of work, $30,000. C. E. Browlby, Mayor.

Neb., Fullerton—City has authorized constr. of sewers on several streets; 2,000 ft. 10-in. pipe; 4,000 ft. 8-in. pipe; 10 manholes; 3 flush tanks. Est. $8.750. G. E. Mark, City Clk.

Neb., Geneva—S. A. Gnaglia & Co., Omaha, awarded contract for sewer constr. at $30,224.

Neb., Grand Island—Wm. Kelly & Son, awarded contract for sewer construction at $2,465.

Neb., Humphrey—A. Dobson, 3140 Sheridan Blvd., Lincoln, awarded contract by city for bldg. 3¼ mi. sanitary sewer, 8.12-in. vitr. pipe, at $24,950.

Neb., Nebraska City—Union Pipe Co., awarded general contract for sewers at $48,500.

Neb., Nebraska City—Keystone Pipe Co., awarded contract for sewers on south side of city, at $48,535.

Neb., Omaha—Katz Constr. Co., 409 Brandeis Bldg., awarded contract for bldg. 10,485 ft. 8.30-in vitr. sewers in L and M streets—38th to 41st streets, at $18,348.

N. J., Belleville—Belleville Bd. of Commrs. voted to carry on constr. of sanitary

sewer section No. 7, at once, under supervision of Commr. Jno. J. Hannan, Director of Public Impvts. Est. cost of project, $100,000.

N. J., Camden—Jno. M. Kelly Constr. Co., 507 Federal St., awarded contr. for furnishing labor and material for constructing sewer drain on 10th street, 32nd, Harrison avenue, Hayes, avenue, River avenue, Westfield avenue, 36th street and Trinity avenue.

N. J., Perth Amboy—Graham & McKeon, City, awarded contract for garbage collection for 3 years at $127,500.

N. J., South Orange—Sts. and Hwys. Comm., of Village Board, after advocating expendt. of from $15,000 to $20,000 for storm sewers in South Orange Village, authorized to make plans for piping several streams in village.

N. Y., Birmingham—C. W. Rose, awarded contract by Bd. Contract & Supply, for bldg. 9 lengths of sewer in various sections of city, at $14,307.

N. Y., Brooklyn—Rosenthan Engrg. Co., 228 Jackson St., awarded contract for labor and material for bldg. sewers in Rutland Rd.—Remsen to Nostrand avenues, at $242,511.

N. Y., Brooklyn—Fenlack Constr. Co., Brooklyn, awarded contract for furnishing labor and material for bldg. sewers in Rutland Rd.—Remsen to Nostrand avenues, at $242,223.

N. Y., Brookyln—C. W. MacDonald, 1910 Webster Ave., New York City, awarded contract for furnishing labor and material for bldg. sewer in avenue U, at $195,801.

N. Y., Brooklyn—City plans to expend $6,700,000 for improvements during 1919. Funds available. About $1,319,000 included for sewer work.

N. Y., Brooklyn—Boro. Pres. Connolly has promised residents of the Fifth Ward, comprising the Rockaways, a comprehensive system of sewers. Engrs. of the Topographical Bureau have plans well under way. He hopes to take up the question with Bd. of Estimate at early date. A system must be installed that will carry the sewage matter from one sect. to another by compressed air. Plans involve constr. of number of ejector stas., manholes in which is an automatic pump; pump to be worked by compressed air furnished from disposal plant. Plant will be erected at some central point, possibly out on the meadows no. of Averne.

N. Y., Buffalo—Graham & Henderson, Cleveland, awarded contract for excavating and laying sewer in Ogden street, to drain 1,000 acres outside of city and to relieve flood conditions of East Buffalo, at $347,-917. Wk. involves 11,000 ft. 96-in. segmental blk. sewer, 78,500 cu. yds. earth and 6,000 cu. yds. rock trenching.

N. Y., Clifton City—$27,000 bonds voted by city for trunk sewers.

N. Y., Freeport (L. I.)—Health Officer advocates bldg. sewage disposal plant. It will cost $975,000 to build plant which will serve every street in village.

N. Y., Utica — Domenick Pirritano awarded contract for sewer in Oak Lane, at $852.60 and in Wilder avenue at $1,473.

N. C., Zebulon—$15,000 bonds voted for sewer construction.

N. D., Valley City—City will construct sewers in Dist. No. 1. City Engr. preparing plans. M. J. Boyd, City Aud.

O., Akron—R. Winthrop Pratt, Cleveland, retained by City Council as consulting engineer for rebldg. sewage disposal system in Kenmore, O. He has submitted report to Council which involves two systems of reconstr. One calls for alterations on present plant amounting to $175,000 and the other for a new filtration plant costing $300,000.

O., Akron—Ords. passed to proceed with construction of sewer laterals and water service connections; also establishing grade and constructing walks in sections of about 16 streets. J. B. Merriman, Pres. of Council; H. N. Seiler, Clk.

O., Akron—McAloan Bros., awarded contract for constructing sewers and paving on Carpenter and Uhler streets at $29,004. Donnelly & McKeon, Cleveland, awarded contract for constructing sewer in West Exchange street, at $102,524.

O., Barberton—W. J. Irvin, Greenville, awarded contract for constr. of sanitary lateral sewers in No. Barberton, at $75.000.

O., Cincinnati—D. P. Foley, awarded contract for constr. of a section of the Mill creek intercepter sewer at $212,170.

O., Cincinnati—Thos. P. Strack awarded contract for constructing sewers in Larado avenue at $2,777.

O., Cincinnati—It has been decided to construct a sewer in Glen Armond avenue —Hamilton avenue to Janet avenue, at $1,300.

O., Cleveland—City let contract for bldg. sewer in Miles avenue—E. 133rd street to city limits, to Manson Company, 34 The Arcade, at $20,978; Bellaire Rd.—Jasper avenue to Big creek, to Brookside Constr. Co., 3905 W. 20th St., at $10,310; Superior avenue—E. 12th to 22nd streets to P. Cinaci, 11811 Browning Ave., at $31,916.

O., Columbus—J. B. Sheets Co., awarded contract for sewer in Park street south from Whittier to Federick street, at 1,256; L. B. Wilkinson, contract for sewer in 11th avenue—Cleveland to St. Clair, at $1,494.

O., Hamilton—Resolution drawn up to construct sanitary sewers, house connections and water service connections in connecting with paving work in various sections of about 8 streets. Karl E. Krieger, Clk. of Council.

O., Lancaster—Wm. Strachan, awarded two sewer contracts; one on Wilson ave-at $2,543 and one in alley No. of Fair avenue at $220.20.

O., Marion—Ord. passed to proceed with constr. of sanitary sewer and a storm sewer in Senate street—Silver street to Hocking Valley railway. J. L. Landes, Clk.

O., Toledo—Work will start about September on the Ten-Mile Crk. sewer, which will tap residence dist. no. of Ten-Mile Crk. and Bancroft street. Plans submitted by Fuller & McClintock, Engrs. Est. cost of sewer, $1,000,000. Sewer will start at Ten Mile Crk. and Monroe street and run down the creek valley to city blvd., at Overland office bldg., and follow the blvd. and Manhattan road to Bayview Park.

O., Vermillion—Resolution adopted to construct sewers and sewage disposal plant in village. W. H. Mitchell, Mayor.

O., Youngstown—Resolution passed to construct sewers in Dale street—Garland to Albert streets; in Kimmel—Dale to Albert, and in Bentley avenue—Dale to Kimmel; also in Richview avenue—Lot 21107 to Connecticut avenue. M. F. Hyland, Clk.; A. W. Craver, Mayor.

O., Youngstown—S. H. DeGroodt awarded contract for Craven street sewer, Federal to Burlington street, at $4,506; P. Grady, contract for Harvard street sewer, Clifton

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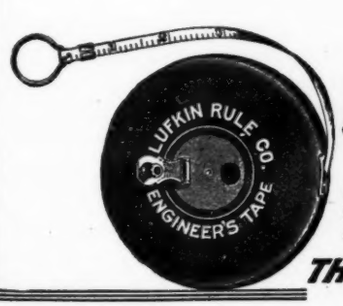

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street to Raymond street, at $3,015, also contr. for Decatur street sewer, Blaine avenue to Gladstone street, at $2,156.

Okla., Bartlesville—City having plans prepared by City Engr., for sanitary sewer system.

Okla., Picher—Macintosh-Walton Engineering Co., Okla. City, awarded contract to construct sewer system, at $80,000.

Ore., Eugene—Council has directed city engineer to prepare plans for sewer on Third and High streets.

Pa., Coatesville—Dunleavy Bros., Coatesville, awarded contract for storm water and sanitary sewers here at $11,367.

Pa., Meadville—Keystone Construction Co., Meadville, Pa., awarded contract by F. C. Kiebort, City Clk., for constructing new pump station; also Tony Trifilletti, Lorain, O., contract for sanitary sewers here.

Pa., Mont Alto—Simpson & Brown, 90 West St., New York City, awarded contract by Dept. of Health, Harrisburg, for furnishing labor and material for bldg. and equipping, extensions, to sewage disposal plant at State Sanitorium for Tuberculosis, near here, at 23,031.

Pa., Wilkinsburg—Federal Construction Co., Pittsburgh, awarded contract by Boro., for bldg. concrete culvert to enclose Nine Mile Run, at abt. $15,150.

R. I., Providence—Comm. of Aldermen has recommended appropriations for two sewers; one in High street — Bedford northerly 200 ft., at cost of $4,000; the other in Buckley street—present terminus to Elizabeth street, at $5,500. Chrmn. Kenworthy, of Sewer Committee, recently submitted order requesting that finance committe consider adviability of raising $50,000 or more for sewer construction.

S. D., Parkston—Ellerman-McLain, Yankton, awarded contract for sanitary sewer and extension of water mains at $59,573.

S. D. — Platt, Thomas E. Wooley, 148 West Ave., S. La Crosse, Wis., awrd. contract for constr. of sewers at $58,712.

Tex., Dallas—Klein Bros. awarded contract for constr. of storm sewer on Douglas St., in district, cost $73,691..

Wash., Seattle—Colson Construction Co., 510 Lowman Bldg., awarded contract for sewer construction on 42nd Ave., So., et al, at $362,262.50.

Wis., Milwaukee—Mid-Western Co., Chicago, will in all probability be awarded contract for constructing 1,800 ft. intercepting sewer from 7th street to 17th street in Menobinee valley, at its bid of $86,100.

WATER SUPPLY AND PURIFICATION

Ariz., Florence—Following contracts awarded for constructing water works and electric light plant: Douseman-Warner Co., Kansas City, Mo., contract for machinery at $30,000; Pacific Pipe and Tile Co., Los Angeles, contr. for wood pipe at $11,242; Des Moines Bridge and Iron Co., Des Moines, contr. for tank work at $8,000.

Ariz., Gila Bend—Sherer & Crowley, 607 Pacific Electric Bldg., Los Angeles, awarded contract for construction of rein. conc. diversion dam and headgate just below site of old Gila Bend dam, and to restore main canal of Gila Bend irrig. proj. for Gila Bend Water Co., at $695,000.

Ill., Chicago—Following contracts awarded for water service pipes in various streets: Daniel Harden. (work covered by warrant Nos.); Jas. R Renn, (1) and Fred Seip (2 Nos.—sys. of streets).

Ind., Bloomington—Frank Sullivan, City, awarded contract for contsr. of Graham street water main, at $1,032.

Ia., Brighton—Des Moines Bridge & Iron Co.,, Des Moines, awarded contr. for water works system at $24,950.

Kans., Topeka — Minor Woodling Co., Kans. City, Mo., awarded contract for installing a vacuum system and water supply system here in State Capitol Bldg., at $29,735.

Mass., Boston—C. & H. Construction Co., contract for laying high pressure fire pipe in Federal street—Purchase to Milk sts.; Frankline street—Oliver to Devonshire streets; Devonshire st.—Summer to Water streets; Water street—Devonshire to Congress street, city proper, at $31,350; J. Guarino & Co., contract for laying and relaying water pipes in Norwell street—Carmen street 150 ft. north! Fireport street—Tenean street 250 ft. north; Glendale street, 250 ft. north and Glendale street— Hancock street to Columbia Road, Dorchester, at $1,751.

Mich., Dearborn — Monie-Dunbar Contracting Co., 901 Chemical Bldg., St. Louis, awarded contract for extensions of water mains at $78,000.

Mich., Grosse Pointe—Cronin and Son, Grosse Pointe, awarded contract for furnishing and laying 2,120 ft. 6-in. c. i. pipe, etc. in University Pl., Kercheval Ave. and Cadieux Rd., at about $5,000.

Minn., Albert Lea—McManis & Tarnoski, 484 Endicott Bldg., St. Paul, awarded contract for concrete reservoir, tank and tower, at $4,600; piping, valves, pump and steam turbine, to Wm. Danforth, 707 Germania Life Bldg., St. Paul, at $10,200.

Minn., Duluth—Norquist & Berg awarded contract for laying gas and water mains in Tacony street, at $2,398; Simon Johnston, awarded contr. for laying gas and water mains in Mankito, Nashua, Superior and Vernon Sts. at $9,206.

Minn., Eveleth—Lawrence & McCann, City, awarded contract for laying approx. 5,000 lin. ft. sewer pipe and 150 ft. water line within the village; also for installing 2 septic tanks and sewer pumphouse.

Mont., Baker—Gibney & Murphey, Minneapolis, awarded contract (general) for improving waer works and sewage systems, at $22,787; c. i. pipe to National Cast Iron Pipe Co., Chicago, at $13,061; hydrants at R. D. Wood, 400 Chestnut St., Philadelphia, at $3,392.

Mont., Hardin — Yergey & Brandriff, Bozeman, awarded contract for laying 13,910 lin. ft. 4-6 in. Matheson pipe, 22 hydrants, necessary valves and fittings, at about $24,000.

N. J., Newark.,—Osborne & Marsellis, awarded contract for laying 1,000 ft. 24-in. conc. drain in Wachtung Ave., Montclair, at abt. $1,800.

N. Y., Phelps—Norwood Engineering Co., Florence, Mass., awarded contract for constructing filtering plant at $24,960; U. S Cast Iron Pipe and Foundry Co., Buffalo, awarded contract for pipe line to convey water from reservoir to Newark, at $85,405.

N. D., Larimore—Gedney & Murphy, Minneapolis, awarded contract for construction of water works system. Waterous fire hydrant was specified and will be used in extension of water works system at Scotland, S. D., Parinston, S. D., Rushford, Minn., Sheldon, N. D., etc., T. R. Arnold, Engr., 1011 Plymouth Bldg., Minneapolis.

O., Akron—T. E. McShaffrey Constr. Co., 173 So. Forge street., awarded contr. for furnishing and laying 2.3 miles 48-in. lock bar steel pipe anl o. i. 36-in. c. i. pipe.

O., Bryan—Toledo Residence Constr. Co., 322 Nasby Bldg., Toledo, awarded contract for 1,000,000-gal. conc. reservoir and pump house, at $23,700; 14,500 ft. 4, 6 and 8 in. c. i. water mains to Gessner Co., 616 Nicholas Bldg., Toledo, at $24,990; sinking two 10-in. wells to R. E. Kersey, South Bend, Ind., at $6,75 per foot.

O., Bellevue—Fred R. Jones, Cleveland, awarded contract for construction of Bellevue's new reservoir, which will have a storage capacity of $140,000,000 gals.

O., Columbus—J. B. Sheets Co., New Hayden, Bldg., Columbus, Ohio, awarded contract for lowering a 36-in. c. i. water main across the Scioto river at $9,460.

O., Salem—Jones Construction Co., Salem, awarded contract for bldg. additional filteration beds, at $30,800.

O., Silver Lake—Gangl Construction Co., Akron, awarded contract for furnishing and laying 17,000 ft. 6-12 in. c. i. water mains, at about $28,000.

Okla., Picher—McIntosh-Walton Engineering Co., Oklahoma City, Okla., awarded contract to construct water works, at $170,000.

Pa., Mont Alto—W. M. Anderson, 600 Schulykill Ave., Phila., awarded contract for bldg. extension to water supply system at Penn. State Sanitorium for Tuberculosis, near here, at about $31,759. Work involves 17,000 ft. ⅝-in. c. i. and 2,500 ft. w. i. pipe.

Pa., Pottsville—The Girard Water Co., Thompson Bldg., awarded contract for bldg. earth fill dam, 870 ft. long, 235 ft. wide, at base with conc. gate-tower, brdg., spillway and cut-off walls, to impound waters on Whiskey Mill Creek, to Central Construction Corp., Commonwealth Trust Bldg., Harrisburg, at $170,551, plus 10 per cent.

Pa., Ringtown — Central Constr. Co., Harrisburg, Pa., awarded contract for constructing new additional reservoir near here.

Tex., Cisco—National Water Purifying Co., Dallas, awarded contract to construct two filtering plants; daily capacity 700,000 gals., at $25,000.

Tex., Stamford—American Cast Iron Pipe Co., Birmingham, Ala., awarded contract to construct reservoir, 12 mi. concrete pipe line—river to pumping station, and two mi. c. i. pipe line—pumping station to Stamford; at $200,000; List & Gifford, contract to construct dam across Clear Fork of Brazos river, including 9,000 cu. yds. rubble and conc. masonry, 70,000 cu. yds. earthwork, etc. List & Gifford, located at Kansas City, Mo. Contract price, $100,000.

Wash., Bellingham — Coast Culvert & Flume Co., awarded contract for 5,500 ft. pipe to replace water main between Mausoleum and James street, at $17,125.

Wash., Seattle—Scalzo & Co., Seattle, awarded contract for laying 3,710 ft. 8-in. c. i. water mains in 60th Ave., S. W., et al, at $12,970.

Wash., Seattle—Joe Di Julio, awarded contract for laying watermains in L. I. D. 3189 Ninth Ave., N. E., at $3,670.

BRIDGES AND BUILDINGS.

Ark., Marked Tree—Larimer & Burget Bridge Co., Memphis, Tenn., award. contract to construct bridges; four 50-ft. steel-plate girder spans, 18 ft. wide; two 50-ft. steel truss spans, 16 ft. wide; 400 lin. ft. conc. viaduct, 18 ft. wide; 112 lin. ft. short-span bridges, 16 ft. wide; several conc. culverts, at $45,000.

Cal., San Francisco—Frank L. Smith, Eureka, awarded contract for bldg. Salmon River brdg., on road bet. Yreka and Somes Bar, at $7,600.

Ga., Cochran—Moultrie Construction Co., Moultrie, Ga., awarded contract to construct bridge, rein. conc. arches, at $26,700.

Ga., Griffith — Austin Bros., Atlanta, awarded contract to construct steel bridge across Flint River at People's Crossing, between Brooks and Vaughn.

Ga., Lafayette—L. C. Smallwood Contracting Co., Chattanooga, Tenn., awarded contract for constructing bridge over Lawrence near Rock Sprgs., also over Rock Creek near Henkles; also brdg. over East Armuchee Creek near Willanow and over Dry Crk., near Rossville, at $14,993.

Ga., Mason—Commrs. of Montgomery and Wheeler counties have awarded contract for constr. of steel bridge across Oconee river, near Mt. Vernon, in three sections, as follows: Contract No. 1 includes clearing of abt. 6 acres and bldg. abt. 29,000 cu. yds. embankment, etc., which will be done by Montgomery county; Contract No. 2, awarded Southern Constr. Co., Birmingham, Ala., at $81,794. This includes steel sect. of brdg. & draw-span complete with reinforcing material; C. T. Dawkins Constr Co., third contract, which includes conc. work in general, including piers, etc., at $81,745.

Ga., Macon—W. D. Griffin, awarded contracts for bldg. three conc. bridges, at $34,571: Parker road brdg. over Tobesofkee rd., at $16,013; Clinton rd. brdg. over Walnut creek at $14,833, and brdg on Riggins Mill road over Swift creek at $3,723. First two named spans will be 144 ft. each in length and Swift creek struct. 20 ft. in length.

Ill., Springfield — Hustedde & Burhorn, Breese, Ill., award. contr. for Renschen bridge, Breese Twp., Clinton Co., at $485; Northern Steel & Conc. Co., Freeport, awarded contr. for Frank Berg brdg., Caledonia Twp., Boone Co., at $5,062.

Ill., Springfield—Paul Loesch, Red Bud, Ill., awarded contract for four brdgs., Sect. D, Randolph Co., at $6,354; W. C. Johnson, Belleville, Ill., contract for Brueggeman brdg., betw. Covington and Nashville Twps., Washington Co., at $2,100; Peter Etling, Ashley, Ill., awarded contr. for Rewalinski and Lamozyk brdg., DuBois Twps., Washington Co., at $2,006; Daniel Kief, Low Point, Ill., contr. for Twin brdg., Minonk Twp., at $2,945; Illinois Steel Bridge Co., contr. for Bloomfield brdg., Missouri Twp., Brown Co., at $4,855; Hilding M. Olson, Crystal Lake, Ill., contr. for Cropley brdg., Richmond Twp., McHenry Co., at $2,500.

Ind., Evansville—International Steel and Iron Co., City, awarded contract for repairing the Stroud Branch brdg., in Union Twp., Vanderburgh Co., at $2,095.

Iowa, Atlantic — Wilson Concrete Co., Red Oak, Iowa, awarded contract by Cass Co., for 25 cencrete culverts and bridge abutments, at $3,764.

Iowa, Chariton—Bd. Supvrs., Lucas Co., let contr. for bldg. 18x60 ft., truss bridge, conc. floor and abutments, 16x32 ft. I-beam conc. flr. abutms. andone I-beam brdg., with three 18x18 ft. spans, to Pittsburg Des Moines Steel Co., 4th street, so. of Tuttle, Des Moines, at $14,500.

Iowa, Newton—A. Phelps & Son, Knoxville, awarded contract by Bd. Supvrs. Jasper county, for bldg. three pony truss bridges, conc. floor and abutments, at $19,270; M. M. Stark & Co., 1215 Mulberry St., Des Moines, three I-beam brdgs., conc. flrs. & abutms., at $10,130. Work involves 8,702 cu. yds. rein. conc., 40 tons struct., and 28 tons reinforcing steel.

Iowa, Waterloo — Miller-Fifield Constr.

Co., awarded contract for following brdgs: Blackhawk Bridge at $44,441; Park Rd. bridge at $4,400 and Logan Ave., brdg., at $3,700; also contr. for reinf. conc. deck girder brdg., with retaining walls and earth embankment, approaches across Blackhawk creek, at $52,511.

Ill., Watseka — Joliet Bridge & Constr. Co., Joliet, awarded contract by Iroquois Co. for bldg. one 60-ft. rein.-conc. span brdg., at $7,498; Continental Bridge Co., 53 W. Jackson St., Chicago, contr. for 100-ft. span Sect. I-15d, at $11,345.

Kan., El Dorado—Maxwell Construction Co., Columbus, awarded contract for five concrete bridges, at $8,615.

Mich., Flint—Price Bros. Co., East Jordan, awarded contract for bldg., 70 ft. rein. conc. bridge over Theat creek on 2nd street, 26 ft. wide, at $23,500.

Mich., Kenton—R. L. Ericson, Bessemer, Mich., awarded contract (general) for trunk line bridge No. 190, at $7,630.

Mich., Nestoria—Illinois Bridge Co., 1623 Monadnock Blk., Chicago, awarded general contract for Trunk Line Bridge No. 124 over Tioga river—abt. 4 miles southwest of here, at $2,786.

Minn., Ada—Hussey Construction Co., Crookston, Minn., awarded contr. for 31 bridges; also excavating ditch and concrete bulkhead, at $41,100.

Minn., Champlin—Ernest M. Ganley Co., 1002 Plymouth Bldg., Minneapolis, award. contract for abt. 35-ft. span (r. c.) with conc. abutments, 20-ft. rdway.

Mo., Excelsior Springs — Topeka Bridge Co., awarded contract to construct Muddy Fork bridge near Morrow farm northeast of Kearney, at $5,965; also awarded contract to build culverts.

Mo., Forsythe—Pioneer Construction Co., Kansas City Mo., awarded contract for bridge over White River, at $20,000.

Minn., Ivanhoe—P. D. Bidwell, Avco, Minn., awarded contr. for bldg. brdg. No. 3037 on State Rd. No. 2, at $2,580.

Neb., Nebraska City—Central Bridge & Constr. Co., city, awarded contract for steel and conc. bridge contracts for remainder of year.

N. J., Brielle—F. Brower, Freehold, awarded contract for replanking and replacing stringers on drawbridge over Manasquan river, between here and Point Pleasant—1,886 ft. long—at $16,048.

N. Y., Rome—Scott Bros., Arlington Blk., awarded contract for bldg. 8-ft. pipe culvert over Barge Canal here, at $46,731.

N. D., Devils Lake—Minneapolis Bridge Co., 1129 Metropolitan Life Bldg., Minneapolis, awarded general contract for seven concrete bridges in various sections of Ramsey County, at $5,800.

N. D., Forman—Iowa Bridge Co., 317 McKnight Bldg., Minneapolis, awarded contract for bridges, conc. culverts and repairing bridges for 1919.

O., Cardington—Geo. F. Wieland, award. contract to construct Hurr brdg., in Washington Twp., at $5,389.

O., Columbus—N. R. Porterfield, Youngstown, O., awarded contract for construction of bridges over west fork of Beaver crk., at $13,331.

Pa., Scranton—Anthracite Bridge Co., Mearse Bldg., awarded contract for improving and repairing Lackawanna Ave. bridge, at $21,147.

Pa., Williamsport—Walter R. Cliffe Co., Philadelphia, awarded contract for constructing bridge over Susquehanna river at Montgomery, at $259,500.

Pa., Williamsport — Following awarded contracts by Co. Commrs.: Jno. Sanders, constr. of seven bridges and conc. floor at Barbours Mills, A. C. Mahaffeye, McHenry Twp. brdg., and Michael Wolf, contr. for pier nose on the Jersey Shore bridge.

S. D., Aberdeen—J. W. Humphrey, Pingree, N. D., awarded contract for graveling, grading and furnishing and installing corrugated metal culverts and monolithic culverts on 12.84 miles of road east and west through Groton, at $64,159.

S. C., Lockhart — Southern Bridge Co., Birmingham, Ala., awarded contract by Chester and Union Counties for bldg. 694 ft. brdg. over Broad river at $59,016.

Tenn., Memphis — Larimer & Burget Bridge Co., Memphis, awarded contracts for construction of bridges in the Ozark Trail Impvt. District, Poinsett County, Arkansas, at about $45,000. Work includes constr. of four 50-ft. steel plate girder spans, 18 ft. wide; two 50-ft. steel truss spans 16-ft. wide; 400 lin. ft. conc. viaduct 18 ft. wide; 112 lin. ft. short span bridges, 16 ft. wide and constr. of several rein. conc. culverts.

Wash., Olympia—Fleiness & Dahl, Seattle, awarded contracts for concrete brdgs. on Pacific Highway betw. Marysville and Silvana, at $23,710. Work covers five small structures.

Wash., Orting—D. W. Rutherford, Municipal Dock, Tacoma, awarded contract by Comrs. Pierce Co., for bldg. 180 ft. Baltimore Truss brdg. conc. pile and trestle approaches, near here, at $24,200.

Wash., Seattle—H. C. Malott, 6526 17th Ave., Northeast, awarded contr. for construction of concrete culverts in Adams County, at $13,437.

Wash., Spokane—C. A. McClung, award. contract for constr. of Mullan bridge across Latah, at $12,700; Carlson-Norman Co., awarded contract for hwy. on western bound. Glacier Natl. Pk., to cost $125,000 to $150,000.

Wash., Tacoma—D. W. Rutherford, Tacoma, award. contract for constructing 180 ft. steel Baltimore truss bridge, at $22,439.

W. Va., Alpoca—Luten Bridge Co., York, Pa., awarded contract to constr. 2 rein. conc. bridges, each 75 ft. span; near Alpoca; one near Bud, W. Va., at total cost of $13,000.

W. Va., Pineville — Luten Bridge Co., Huntington, awarded contract by Comrs. Wyoming Co., for bldg two concrete arch bridges over Barkers' Run, at $12,416.

Wis., Alma—H. W. Phillips, Galesville, Wis., awarded general contract for Duff bridge, at $2,544; also Servais bridge at $2,445; H. F. Hurley, Mendovi, contract for Wm. Loomis brdg., at $4,995 and Quarberg brdg., at $680; La Cresse Brdg. Co., general contract for Beef River brdg., at $12,187; Meyers Bridge Co., Mendovi, general contr. for Kried brdg., at $783, Espen brdg., $1,450 and Cascade brdg., at $3,120; Fred Metzler, Mendovi, general contract for Pape brdg., at $900, Solwey brdg., at $550.

Wis., Arcadia—C. A. Sweet & E. G. Bigham, city, awarded contracts for three bridges in county: Strum bridge at $8,500; Carhart bridge, at $3,050; the Gibson brdg. at $3,700.

Wis., Black River Falls—Ole Tormoen, Blair, Wis., awarded contract by Jackson Co., Town of Irving, at $4,138 for High bridge culvert, reinf. concrete.

Wis., Owen—Harvey Green, Colby, Wis., awarded contract for conc. brdgs. and wood piles at $8,807; also conc. culverts to Andrew Braun, Neillsville, Wis., at $4,509.

Wis., Wild Rose—C. Radley, Wautoma, awarded contract for River Street bridge, at $1,398.

PROSPECTIVE WORK

ROADS AND STREETS.

Ariz., Phoenix—Maricopa County has voted $4,000,000 bond issue to be expended on system of county roads, which will place paved blvd. within a mile and a half of practically every home in settled portion of county.

Ariz., Phoenix—Maricopa County going to expend $4,000,000 for paving 172 miles of roads in county.

Ark., Sheridan—Grant Co. Commrs. Rd. Impvt. Dist. No. 5, has engaged Pritchard & Hlett, Little Rock, as engineers for 19 miles of road construction from Dallas Co. line, so. of Leola, to Payne. T. M. Harris, Commr.

Ark., Walnut Ridge—Dickinson & Watkins will survey Walnut Ridge-Alicia Rd., which parallels Missouri-Pacific R. R., from Walnut Ridge to Jackson county line.

Conn., Norfolk—Town voted unanimously to construct section of new hwy., in conjunction with state in Hall Meadow, So. Norfolk. Est. cost $26,000.

Cal., Oakland—Hwy. from Red Bluff to Oregon line is to be paved and pavement from San Francisco to Red Bluff will be completed.

Conn., So. Manchester—All streets and roads here will be repaired and a park of 47 acres developed. Est. cost of park improvement, $20,000 or more. J. Frank Bowen, Engr.-Supt.

Fla., Bunnell—Flagler County, Shell Bluff Special Rd. & Bridge Dist., will grade, drain and hard-surface roads and construct bridges; 26 miles of highway. Will expend proceeds of $99,500 bond issue. Peter Kendrick, Engr.

Fla., Jacksonville—K. B. Harvey, Room 827, Hotel Seminole, will constr. hard-surface road through inaccessible pine and hardwood section of Florida. Will purchase machinery.

Fla., Miami—Questions of repaving 12th street with asph., creation of sanitary district, comprising territory north of Johnson street, and betw. Biscayne Drive on East and Columbia Ave., on the west; also constr. of 121,580 sq. ft. cement walks in various "missing links" throughout the city, are being considered by Special Council. Est. cost of 12th st. paving $38,000; sidewalk impvt., $124,000.

Fla., Seabreeze—C. M. Rogers, Daytona, Fla., retained by city as engineer for 3 or 4 miles of paving, including drainage, $180,000.

Ga., Gainesville—Hall County will construct concrete roads. Garrett and Slack, Engrs., Montgomery, Ala. F. T. Davis, Chrmn. Co. Commrs., Flowery Branch, Ga.

Ga., Madison—Morgan County Commrs., W. H. Kimbrough, chrmn., will constr. 60 miles of concrete roads; $325,000 bonds voted and may receive $325,000 state appropriation. Johnston & Morgan, Engrs., 609 Flatiron Bldg., Atlanta, Ga.

Idaho, Twin Falls—City has voted two-year municipal impvt. program involving assurance of $205,000 worth of municipal bonds and an aggregate expenditure, with paving assessment bonds to be paid by individuals, of about $75,000. Three propositions submitted as follows: $115,000 for paving, $50,000 for bridge across Rock

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creek on Shoshone street; $40,000 for extension of trunk line sewer.

Idaho, Nampa—$500,000 bonds voted in Nampa Hwy. Dist. Preparations for road impvt. program will begin at once; bonds to be sold immediately. Machinery, including trucks and road material machines will be purchased.

Ill., Belleville—Co. Supt. of Hwys. Thomas has completed plat for extension of No. Chestnut street—present terminus to Poor House road, leading from North Race street to Manties Park.

Ill., Decatur—Petition being circulated for paving of East Eldorado St.—Main St. east to Seventh St. Petition also presented to Council for paving of West Grand Ave., with brick for abt. 10 blocks; width of pavement to be 28 ft.

Ill., East Moline—Paving of 22 blks., in Third Ward favorably acted upon by Bd. of Local Impvts.

Ill., East St. Louis—Good Rds. Comn. of Chamber of Commerce considering plan of constructing hwy. 100 ft. wide from Ninth street and the L. & N. tracks, east of Stockyards, to Madison.

Ill., Galesburg—Petition being circulated for paving Monmouth Blvd. and Grand Ave., to city limits.

Ill., Rockford—Estimates on six proposed pavement impvts. and on two sewer services, presented by Public Engr. S. B. Hand to Board of Local Impvts; $150,000. Largest est. was for paving of Charles Street with brick—7th to 18th Ave., $94,500; concrete paving for Douglass Street being planned; $19,500; conc. paving under consideration for sections of Browns Ave., $13,920. It is also planned to pave Alley Blks. 8 and 17 of Harlem Park subdivision with conc.; $1,680 and $1,624, respectively.

Ill., Springfield—Petition in circulation and will soon be presented to Board of Local Impvts., for paving of Laurel street—Second to 15th streets; pavement to be 30 ft. wide and of brick.

Ill., Springfield—House has passed four good road appropriation bills totalling $14,717,252.

Ill., Waukegan—In resolutions presented before Bd. of Local Impvts., the paving of a network of streets in south side is estimated at $87,716. Streets, which are to be paved with brick (asph. filler), to width of 25 ft., are as follows: So. Utica—Belvidere to South Ave.; Liberty—South Sheridan Rd. to Oak, and from Oak to S. Utica; So. Utica—Belvidere to Liberty; McKinley Ave.—Sheridan Rd. to Oak; Oak to So. Utica and from So. Utica to McAlister; Caroline Bl.—Ravine to So. Aves.; George Ave.—S. Utica to Caroline Pl., from Caroline Pl. to McAlister Ave., and from McAlister to Sunderlin street; An important impvt. is the paving with concrete, 30 ft. wide, of Cummings Ave. Est. cost $29,914.

Ind., Albion—Petiton filed for grading, paving and improving certain hwys. in Noble county. Recommendation is made that hwy. be graded to width of 28 ft., exclusive of side ditches and that center of drway. be paved with 1-course brick pavement 9 ft. wide on each side of center line from place of beginning, through town of Cromwell to south corp. line in town, and from corp. line hwy. to be paved with 1-course gravel at least 12 ins. in thickness, 9 ft. wide on each side of center line of rdway. rest of distance. H. Clayton Erwin, Aud. Noble Co.

Ind., Elkhart—Bd. Public Wks., adopted plans and specifs. prepared by City Engr. Weaver for paving of Fifth St.—Lexington Ave. to Jefferson street; Brady street—Jackson Pl. to Fifth St., and Jackson Pl.—Vistula to 5th.

Ind., Goshen—Sixteen petitions for rd. impvts. filed with Bd. Co. Commrs; following chosen as available for this year: Prairie Street Rd., starting at south end of brick pavement, running south from Elkhart and extending 2 mi. to connect with Lincoln Ave. brk. gravel rd. out of Goshen; abt. 3 mi. of North River Rd., abt. 5 miles Zion Rd.; four mi. Cassopolis Rd. 6 rds. in central and southern part of county, including Goshen-Bristol Rd., 12 miles long, will be passed on by County Council in near future.

Ind., Indianapolis—Plans for establishment of hwys. leading into city from agricultural districts of the north will be considered by Bd. of County Commrs., Bd. Public Wks., and Bd. of Park Commrs. The boards will seek to construct two main hwys leading into stockyards dist., one from the northwest and one from the northeast.

Ind., Logansport—According to present plans, Michigan avenue and a section of Pleasant Hill street will be improved under the 3-mile road law; other preparations being made for impvt. of Seventeenth St.—High St. to Wabash tracks, east to 18th street bridge. Impvt. of Erie Ave., 12th street to end of street—is also planned.

Iowa, Cherokee—City Council planning about 3½ miles of street paving.

Iowa, Davenport—City will pave alley betw. Gaines & Brown streets—13th to 14th streets—with Portland cement conc.; abt. 32 lin. ft. Est. cost, $1,488; also alley betw. Park Lane and Grant St.—Harrison to Brady Sts—with Portland cem. conc.—abt. 1,109 lin. ft. Est. cost $4,869. Hugo Moeller, City Clk.

Iowa, Emmetsburg—Butler County planning to grade first four miles north of Allison on Allison-Green road.

Iowa, Jefferson—City establishing paving districts for purpose of paving Lincoln Hwy. within city limits at east and west edges. Cost of paving one district 18 ft. wide is est. at $30,802.50 for cement, and $40,042.27 for vitr. brk. Cost of paving the other district is estimated at $15,401.25 for conc. and $20,021.13 for vitr. brick. City also preparing to pave several miles of streets.

Iowa, Strawberry Point—Council will pave two miles of main streets.

Kan., La Crosse—Majority of property owners have signed petiton for paving 6 blocks on Main street.

Kan., Topeka—Petitions for 400 miles hard-surf. roads approved by Kansas Co. Commrs., and received by State Hwy. Comn. for consideration as to receiving federal aid. Est. cost of work more than $14,000,000. H. A. Marshall, State Hwy. Engineer's office stated that $5,000,000 of this may be covered by federal aid. Government has appropriated $8,000,000 for aid in bldg. roads in state.

La., Lake Charles—Calcasieu Parish will construct 12 mile rd. from Vinton, La., to Orange, Tex. Floyd Hamilton, Parish Hwy. Engr.

Mass., Boston—With complete co-operation of the Boston Elevated Ry. Co. city will conduct street repairing program, 21 distinct projects having been scheduled to embrace the appropriation of $1,000,000 made available by the legislature in passing the mayor's tax-limit bill.

Mass., Salem—Council has appropriated $150,000 additional to be raised by bond issue for extending blk. paving on Boston street to Peabody line and on Derby street below the boulevard.

Mich., Caro—Engr. Roberts, Saginaw, has completed profiles and estimates for proposed paving on E. Frank and Almer streets in village. Plans ordered filed with village clerk.

Mich., Hastings—Upon requests of residents of eastern section, Barry Co. State Hwy. Comr. Frank R. Rogers has planned trunk line hwy. betw. here and Nashville—about 12 miles. The farmers want rd. continued through Vermontville to Charlotte county and Jackson, but this last impvt. is doubtful.

Mich., Highland Park (Detroit P. O.)—City having plans prepared by L. C. Whitsit, Engr., 20 Gerald Ave., for paving, grading and curbing with asph. concrete on conc. base, 1,200 ft. Brush St.—Ferris Ave. to Six Mile Rd, 2,700 ft. Oakland Ave.—Farrand to Manchester Aves., 1,500 ft. Davison Ave.—Oakland to Grand Trunk R. R. tracks.

Mich., Kalamazoo—City plans to pave with brk. conc. base, Oakland Drive, at $159,498; Douglas Ave., $51,460; Porter St., $20,498; Douglas Ave., $51,460; Porter St., $20,712; Ransom St., $10,778; Pitcher St., $6,500; Church St., $7,456; with asph. conc. Grand Ave., $8,653; Prairie Ave., $14,236. A. Lendrick, city engr.

Mich., Lansing—About $140,000 worth of street paving now in sight for city for this year; about $65,000 now available, representing 20 blks. Petitons filed for paving of 25 additional blocks. Est. cost, $75,000.

Mich., Middleville—City has retained L. A. Boulay, County Engr., 1250 Nicholas Bldg., Toledo, Ohio, to prepare plans for 1½ miles of concrete or brick road, 20-48 ft. wide. About $50,000.

Mich., Standish—Gravel roads will be built from Standish to Pinconning, eight miles; Twining to Omar; Standish to Sterling, five miles and from Standish to Pine river.

Minn., Aitkin—County Board of Aitkin Co. has authorized issuance of $125,000 additional bonds to improve Duluth - Fargo road. H. C. Beecher, Co. Aud.

Minn., Duluth—Property owners have petitioned to pave Third St.—Piedmont to 28th Ave—this summer; also Third St.—Lake Ave to 18th Ave. E. W. H. Borgen, city clerk. Council considering impvt. of 9th Ave. from 14th Ave. E. to Chester Park; 8th street—Chester Park to Woodland Ave.; Cook St.—40th Ave E. to 43d Ave. E., and from 43d to Superior St. Total est. cost, $113,000. W. H. Borgan, city clerk.

Minn., Duluth—Council petitioned to pave Commonwealth Ave. this year, through New Duluth and Gary, with cr. rock, gravel and oil; and also petitioned to pave Railroad St.—Garfield Ave. to 1st Ave. E., hard surface. W. H. Borgan, city clk.

Minn., Luverne—State Rds. Nos. 1, 2 and 3, extending from west line Noble Co., through Magnolia, Luverne, Beaver Crk.; thence to state line of South Dakota—have been designated as state trunk hwy. Conc. paving program, involving expendt. of $175,000 outlined.

Minn., Northfield—Resolution passed by Co. Bd. of Commrs., to submit to State Hwy. Commr., for approval federal aid projects costing $450,000. Roads are as follows: Faribault to Northfield, $300,000; Erintown to Shieldsville, $32,000; Shieldsville to Faribault, $30,000; West Co. line to Morristown, $18,000; Morristown to Faribault, $40,000; Faribault to East Line, 30,000. Govt. will issue to Rice Co., $200,000 to be used for hard-surfacing roads. Entire road program of county calls for expendt. of $541,000 this year, after being properly approved by State Hwys. Depart. Co. Engr. authorized to draw plans and specifs. for all proposed federal and state aid projects.

Minn., St. Paul—Final order passed by Council to pave Cleveland Ave.—University avenue to Marshall Ave. Est. cost of paving with creo. blks., $75,067.

Minn., Virginia—City engineer preparing plans and specfs. for paving of ten alleys. Est. cost betw. $25,000 and $30,000. A. E. Bickford, city clerk.

Minn., Wadena—Federal approval of county's plan to expend $50,000 for road constr. has been received. Engr. Ward will immediately prepare to rush work to completion.

Mo., Clayton—St. Louis County Commrs. will issue $3,000,000 bonds for road construction.

Mo., Kansas City—Plans will be drawn by Park Bd. immediately for paving of Meyer Blvd.—Ward Parkway to the Paseo.

Mo., Marshall—Saline Court has granted petition for hard surfacing of 9 miles of Marshall-Sedalia road on lake to Gulf hwy.

Mo., St. Joseph—A two-way blvd. parked in middle, 80 ft. wide, betw. city and One Hundredth and Two River on asylum rd., is possibility of near future. Property owners willing to give, free of cost to state or county, enough ground to admit of widening thoroughfare to 80 ft.

N. J., Newark—Ords. for paving, curbing and placing sewers in Woodland Pl., Irving and Tichenor Aves., passed on final reading. Streets will be paved with a patented pavement.

N. Y., Brooklyn—City plans to spend $6,700,000 on street improvements this year—funds available. This amount includes sewerage work. Abt. $1,600,000 now available for repaving work.

N. Y., Ithaca—Bd. of Pub. Wks. has designated 8 more streets to be paved this spring. Est. cost, $107,000. Pavement will be of brick.

N. C., Greenville—Pitt County voted $500,000 bonds for purpose of constr. of hard-surfaced roads. Expects to secure $1,500,000 state and federal aid.

N. C., Lenoir—Caldwell County Road Commission will engage engineer to draw plans and specfs. for road work; $250,000 bonds voted. J. L. Cottrell, clk.

N. C., Sparta—Alleghany County voted $125,000 bonds fo rconstr. of roads; expects $125,000 state aid and $250,000 federal aid.

O., Geneva—Thirteen miles of roads between Geneva and Painesville will be paved this summer. Est. cost, $450,000.

Ohio, Cleveland—Resolution drawn up, declaring it necessary to improve and repair Lake Shore blvd. from east line of E. 88th street to abt. 300 ft. west of westerly line of Coit Ave., by laying bithu. wearing surf. over existing macadam. C. A. Neff, clk.

Ohio, Cleveland—City has expended abt. $4,500,000 for municipal impvts, and expects to spend $8,000,000 when entire impvt. program is under way. Bulk of the impvt. program is in the dept. of public service; sewage disposal, $600,000; Carnegie avenue extension, $300,000; garbage disposal, $30,000; paving, $1,500,000; sewers, $1,500,000 and grade crossing, $1,000,000. Utilities Director Farrell estimates his program at $800,000, for new Muny Electric Light Plant and $500,000 in Water Works extension, etc., etc.

O., Elyria—Council has decided that Cornell, Harwood and Princeton avenues should be paved and that East and West avenues, also Lodi street, would be re-

paved during summer. Expt. will total abt. $200,000. City Engr. instructed to prepare cost est. for making impvts. without undue delay.

O., Jefferson—Commrs. have decided to grant petition to build 7½ miles cinder rd. —end of cinder rd., Jefferson Twp. on center road south through Lenox to New Lyme Center. Surveyor estimates cost at $3,700 a mile for road. In Geauga Co., surveyor has estimated 2½ miles conc rd. 10 ft. wide, Claridon Twp., at $35,600, or $14,200 a mile.

O., Hamilton—Resolution adopted to pave Dick Ave.—Park to Cereal Ave., Edgewood Ave.—Main street to Virginia Ave.—Rhea Ave.—Dick to Eaton; Virginia Ave.—Dick to Edgewood; Gray Ave.—Dick to Eaton. Ests. of City Engr. F. E. Weaver on vitr. brick paving is $53,693 and on sheet asph., $49,643.

O., Piqua—New main market road to be built under state supervision is proposed to cross Miami county east and west and traverse Union, Madison, Miami, Darke and Preble counties. Road as proposed will start at Columbus and pass through Plain City, Urbana, Piqua, Greenville, to Ohio-Indiana state line.

Okla., Okmulgee—Resolutions passed by Bd. City Commrs. for paving of ten blks.

Tenn., Memphis—Resolutions will be adopted authorizing City Engr. to begin work on improving Felix, Roland and Beale Aves.; also N. Willett street. Wm. B. Fowler, City Engr.

Tex., Bay City—Matagorda County Rd. Dist No. 8 will construct 15½ miles of roads; issue $65,000 bonds. J. C. Carrington, Engr. Bay City.

Tex., Boston—Bowie County has voted $60,000 bonds to construct roads from Oxford school through Red Water, Maur and Minton Twps., to Pettis bridge, on Sulphur river.

Tex., Cleburne—$2,000,000 road bonds voted by large majority in Johnson county.

Tex., Dallas—$6,500,000 voted for construction of good roads in Dallas county; 85 miles at least will be built of concrete.

Wis., Janesville—Rock County voted $1,500,000 bonds to build concrete roads.

Wis., Neenah—Winnebago Co. Bd. has voted appropriation of $50,000 for permanent impvt. of Appleton-Menasha Rd.; road to be paved with concrete; Board also appropriated $100,000 for road from Winneconne to Omro.

SEWERAGE AND SEWAGE TREATMENT

Ala., Century—Alger-Sullivan Lumber Co. will build $10,000 to $12,000 sewer system.

Ala., Gadsden—City will extend Oak Park addition sewer system. Est. cost $13,000 to $14,000.

Ark., Berryville—Council has decided to install sewer system here. Survey to estimate cost is being made.

Ark., Pocahontas—City has engaged engineer to survey for sewer system.

Cal., Los Angeles—$135,000 bonds voted for constr. of sewer system in Wilmington at Los Angeles harbor.

Cal., Los Angeles—Bd. of Public Works has made application to War Dept. for permission to extend the 22nd street outfall sewer at Los Angeles harbor. City desires to extend the sewer from its present outlet to a point so that the discharge can be made in deep water at west channel of outer harbor.

Conn., Hartford—Bd. of Finance reported favorably on request of Street Commrs. that extra appropriation of $10,000 be made to rebuild section of Nook Farm sewer. Council adopted resolution granting appropriation.

Fla., Chipley—J. B. McCrary Co., Atlata, Ga., engaged by city as engineer in charge of construting sewer system.

Fla., Miami—Councilman Chaille, has submitted plan for new sanitary sewer district, estimated cost of which in one district is $83,000 and in another district $41,000—total for both districts $124,000.

Ill., E. Moline—Bd. of Local Impvts. has decided to extend sewers and water main to entire Fourth Ward.

Ill., Kankakee—Bds. Local Impvts. have voted to construct new storm sewer on River street. City Engr. Gregg instructed to prepare plans, specfs., etc.

Ill., Quincy—Plans made for constr. of sewer in North End. Sewer will be built as a culvert with a diam. of 8 ft. on Locust street end and tapering to a 6-ft. diam. at the Elm street end. Approx. 7,000 ft. in length.

Ill., Rockford—Two sewer improvements planned: One for Mulberry street from Marion avenue, 150 ft. west to Soper avenue, Soper to Mulberry No., 300 ft. and from Alliance avenue to Mulberry north 300 ft. Est. cost $3,000; the other the Sinnissippu street sewer, which will start from a point 410 ft. W. of Main street, east to Main, also extending across No. 10 ft. Blk. 5, lot 1, C. G. Foltz Addn. and from E. line of Main to river. $1,340.

Ind., Anderson—Preliminary plans for constr. of sewer and drainage sys. for Shadeland and Jackson Park ready for approval of Bd. of Wks. According to specfs. by City Engr. Lee main line of sewer to be laid with 24-in. tile, will extend for cor. of Walton and 24th streets. north on Park Ave. to 19th street and east along latter street to Green's branch.

Ind., Bloomington—City considering construction of about one mile of sanitary sewer system extensions and about half a mile of macadam street impvt., with cement walks and gutters. U. S. Hanna, City Engr.

Ind., Huntington—Petition signed by five residents filed with County Clk. for sewer on Fruit and Ivy streets.

Ia., Atlantic—City considering bldg. sewers and catch basins. T. E. Nickols, City Clk.

Ia., Bettendorf—Town Council has decided to extend sewer system from 1,200 to 1,600 ft. Impvt. will be installed from Third street west to the Carmelite bldg.

Ia., Council Bluffs—Resolution adopted by Council to construct sewer as follows: Wilson avenue—8th street to Military avenue, 540 ft., 8-in., 280 ft. 6-in.; Ninth street, 335 ft. 10-in., 346 ft. 8-in. and 432 ft. 6-in. with 2 manholes; Marian avenue, 950 ft. 8-in., 40 ft. 6-in. with 2 manholes; Him street, 200 ft. 8-in.; Helen avenue, entire length, 900 ft. 8-in., 375 ft. 6-in. with 4 manholes; 13th avenue, 345 ft. 8-in., 180 ft. 6-in.; Fifth avenue, 609 ft. 12-in., 1,417 ft. 10-in., 704 ft. 8-in., 2,376 ft. 6-in., 9 manholes; 7th avenue, 609 ft. 12-in., 1,417 ft. 10-in., 704 ft. 8-in., 2,376 ft. 6-in., 9 manholes; 8th avenue, 609 ft. 12-in., 1,417 ft. 10-in., 704 ft. 8-in., 2,376 ft. 6-in., 9 manholes; alley betw. 5th and 6th avenues, from 15th to 16th streets and from 17th to 18th streets, 426 ft. 10-in., 464 ft. 8-in., 1 manhole. C. O. Frazer, City Clk.

Ia., Dysart—Plans under way for con-

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structing sewerage system. Nathaniel Barber, Waterloo, Engr.

Ia., Estherville—Resolution adopted by Council to construct sanitary sewer as follows: 8-in. in S. 6th St.—E. Lincoln to E. Maple Sts.; 6-in. in S. 6th St.—E. Maple to 415 ft. S. of intersect. of S. 6th St. and E. Maple St.; sewers to be constructed with necessary manholes, flush tanks and connections; vitr. salt glazed sewer pipe. Alex Johnston, City Clk.

Ia., Fort Dodge—City considering bldg. sanitary sewers from 20th street and 12th avenue; on 20th street to 19th street; on 19th to 21st. 8-in. pipe, 1 manhole, 1 flush tank, 3 lampholes and 6-in. house connections for each lot. W. L. Tang, City Clk.

Ia., Keokuk—Resolution passed for sewers on B, C, William, Reid, Park streets alley in Blk. 1 and Ried's Addn. Ed. F. Lofton, Mayor; O. W. Sandberg, City Clk.

Ia., Mason City—Petitions filed for sewers on S. Taylor avenue—4th street southwest to 6th street, S. W., and on S. Taylor avenue. Both approved by Council and resolutions authorizing work placed on file.

Ia., Storm Lake—Plans being made by Engr. Flindt for enlargement of present sewer system on scale sufficient to take care of entire city. Est. cost about $75,000.

Ia., Waverly—Resolution passed to construct 8-in. san. sewer on several streets in town. Brick manholes will also be built at each intersection. F. A. Lee, City Clk.

Ia., What Cheer—City will construct sewers. W. I. Meade, City Clk.

Kans., El Dorado—Ord. passed providing for issuance of bonds for constr. of sewers in Sewer Districts Nos. 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39 and 40 in city. Total est. cost of work, $17,944.

Kans., Frontenac—If present plans are carried out sewer system will be built here this summer.

Kans., Salina—Sewer ordinance passed calls for bldg. of sewers as follows: 1,000 ft. on Chicago S. of Elm; 200 ft. on Gypsum west from Oakdale; 23 ft. on Penn. avenue, beginning at manhole in alley east of Penn. then no., north side of Penn.; 3 manholes on Phillips; 400 ft. stubs across Phillip, 525 ft. in alley bet. Kirwin and Claflin east of 4th street from east line of Santa Fe avenue, 20 catchbasins; sewer petition also presented for sewers betw. 3rd and 4th streets south of Mulberry and one on 11th.

La., Homer—City will construct sewer system. Xavier A. Kramer, Consit. Engr., Magnolia, Miss.

La., Natchitoches—City contemplates installing sewerage sytem; also remodeling electric power and water plant.

Mass., Boston—Commr. of Public Works reports that he will construct abt. 180 linr. ft. 6-in., 8-in. and 10-in. pipe house connections and catchbasin connections in Green street—Brookside avenue to Washington street, in West Roxbury district, at est. cost of $1,056; also sanitary sewer of 10-in. earthen and steel pipe in Green street betw. Brookside avenue and Amory street, in West Roxbury district at est. cost of $3,599.

R. I., Woonsocket—Resolution appropriating sum of $67,700 for installing sewers, paving, etc., has been recommended for passage.

S. C., Lake City—City voted bonds to install sewer and water systems. Est. cost $150,000 to $200,000.

S. D., Huron—City considering sewer constr. in three districts—Nos. 52, 53 and 17. J. L. Sankey, Aud.

S. D., Lemmon—Engr. Atkinson has completed survey and prepared plans for sewerage system. Complete plans submitted to City Commrs. Est. cost, $70,000.

S. D., Sioux Falls—City contemplates bldg. sewer on Duluth avenue—18th to 26th street; also on 10th street—Covel avenue to Western avenue.

Tenn., Alton Park—City will engage engineer to prepare plans and spcfs. for sewer system, etc. C. E. Milton, Mayor.

Tenn., Binghamton—Town will issue $15,000 bonds for constr. and repair of sewers, construting streets and walks, etc. H. B. Everett, Chrmn. of Committee.

Tenn., Maryville—$50,000 sewer bonds issued by City. D. F. Young, Mayor.

Tenn., Ripley—City voted $150,000 bonds to construct sewer and water systems, ice and electric light plants. Calvin Conner, Mayor.

Tex., Houston—$50,000 bonds voted for sanitary sewers. A. E. Ammerman, Mayor.

W. Va., Martinsburg—Albright & Mebus, Consit. Engrs., engaged by city to prepare plans for disposal plant and sewerage system.

WATER SUPPLY AND PURIFICATION

Ala., Gadsden—City will have plans prepared by Supt. of Water Dept., for water system in Oak Park Addn, and on Mineral avenue. Est. cost, $13,000 to $14,000.

Ariz., Phoenix—Cost of proposed new gravity water system for Phoenix is estimated to cost $1,315,242. Plans calls for constr. of infiltration galleries in Verde river, near Ft. McDowell; constr. of pipe line and conc. reservoir with 25,000,000 gals. capy. Special elec. may be called to vote bonds for project.

Ark., Booneville—City considering installing water works.

Ark., Marianna—City Commrs. will improve water works. Est. cost, $40,000. J. M. Johnston, Mayor.

Cal., Altadena—Rubio Canyon Land and Water Assn. will install pumping plant at new well on Sacramento street, increasing capy. for pumping water to upper reservoirs and to lay an additional pipe line from the wells to the reservoirs. Est. cost, $10,000.

Cal., Glendale—City Trustees have adopted resolution declaring necessity of impvts. and extensions to water system, including hydro-electric generating plant to cost $196,000. Bond election will be called.

Cal., Inglewood—City voted $217,000 bonds to construct water works sys. Plans include wells, pumps, standpipe, reservoir and distributing sys., or purchase of pumping plant and distributing system of Inglewood Water Co., and extending and improving same. Olmstead & Gillelen, 1112 Hollingsworth Bldg., Los Angeles, Engrs.

Cal., Los Angeles—Citizens in neighborhood of Lancaster, Antelope Valley, want to vote on question of establishing water works dist., which will include Lancaster. Matter before Bd. of Supvrs. Est. cost of project, $30,250.

Cal., San Diego—$2,500 appropriation for constructing 4-in. pipe line—Cass street to the reservoir at Pacific Beach—has been made by city council.

Cal., Santa Barbara—Property owners, of Montecito, contemplate forming water district to provide complete distributing system; water to be purchased from the city. Engr. Jas. R. Chapman suggested impvt.

Colo., Grover—$34,000 bonds voted by city to build water works system and electric light plant.

Fla., Key West—U. S. Government, Department of Commerce, Bureau of Fisheries, will erect rein. conc. water towers; 3 tanks, 17-ft. diam., 42 ft. high. Fuquay & Gheen, Contrs., Daytona Beach, Fla.

Fla., Pensecola—City voted $15,000 bonds to extend and improve water system. J. L. Sweeney, City Engr.

Ga., Savannah—City will improve water works. Install 3,000,000-gal. pump.

Ia., Decorah—City Council passed resolution calling for 14 pieces of extension of water mains on various streets. Total number of feet, 9,754.

Ia., Farragut—$25,000 bonds voted at recent election for construction, this summer, of a municipal water works.

Ia., Lytton—Bd. of Supvrs., Muscatine and Louisa counties, have adopted resolution for constructing additional pumping station in Draing, Dist. No. 13. Will call for bids in near future. H. B. Caple, City Clk.

Ia., Sioux City—Voters have declared themselves in favor of municipal water works. $25,000 bonds sold.

Ky., Louisville—Louisville Water Co., 435 S. 3rd street, plans to improve water works system.

Kans., Hiawatha—City having plans prepared for improving water works sys. Plans include installing pumps at spring on County Farm, etc. Abt. $25,000. Black and Veatch, Interstate Bldg., Kans. City, Mo., Engrs.

Kans., Osborne—City having plans prepared by Archer and Stevens, Engrs., New England Bldg., Kans. City, Mo., for improving water works system.

La., Homer—City will construct water plant. Xavier A. Kramer, Consit. Engr., Magnolia, Miss.

La., Lake Charles—City Commission plans to extend water system and lay additional water mains.

Md., Sparrows Point—Bethlehem Steel Corp., will construct pumping sta.; 75x50-ft. structure. Gladfelter & Chambers, Contractors, 36th street and Roland avenue. Ed. L. Palmer, Archt., 513 N. Charles street, both of Baltimore.

Mass., East Boston (Boston P. O.)—State Water Wks. Comm., Capitol, Boston, had plans prepared for bldg. 36-in. water main, 1,800 ft. long, to supply additional water here. Abt. $40,000. A. O. Doane, 1 Ashburton Pl., Boston, Engineer.

Mass., Lexington—City had plans for bldg. 6,000 ft. 16-in. water main. Abt. $65,000. A. O. Doane, 1 Ashburton Pl., Boston. Engr.

Mass., Milton (Boston P. O.)—State Water Wks. Comn., Capitol Bldg., Boston, had plans prepared for bldg. 12-in. c. i. water main in Poplar street, West Roxbury, and under Neponset river to provide supply to Milton Twp. A. O. Doane, Boston, Engr.

Mich., Manistee—Council has authorized City Manager to proceed with wk. of extending water pipe line from north city limits to Oak Grove cemetery.

Minn., Annandale—Plans being prepared by Druar & Smith, Engrs., St. Paul, for constr. of sanitary sewer system and water works system for village.

Minn., Bemidji—$50,000 bonds sold for water works system.

Minn., Farmington—Consit. Engrs., Druar & Smith, St. Paul, making plans for sewers and water extensions and street paving. Ready for bids in July. E. H. Dosey, City Clk.

Minn., Hinckley—$30,000 bonds voted for purpose of constructing water system. A. J. Hunt, City Clk.

Minn., Walnut Grove—Plans being prepared for constr. of sewer and extension to water works system for village. Druar & Smith, St. Paul, Minn., Engineers.

Mo., Cameron—Council has approved plans for filtration plant to be located near stand pipe. Will call elec. to vote bonds for purpose of bldg plant. Est. cost, $35,000. Engineer Harper's estimates are as follows: $19,500 for constr. of two filters with room for third with capy. of 700,000 gals. of water daily; coagulating basin and clear water well; $2,000 for 500-gals. per min. pump; $1,500 for sewer for carrying water from filter; $2,000 for power house repairs and $10,000 for fire main extensions and 10 new hydrants.

Mo., Walnut Grove—Plans well under way for establishment of city water works system here.

Neb., Alliance—City will construct channels and covered drains to carry water. Grant & Fulton, Engrs., 505 Bankers Life Bldg., Lincoln, Neb. Grace H. Kennedy, Clk.

Neb., Indianola—$32,000 bonds voted at recent election for water wks. system. Sidney Smith, City Clk. Engrs., Grant, Fulton and Letton, 503 Bankers Life Bldg., Lincoln, Neb.

N. C., Eau Claire—City plans vote on $40,000 bonds for construction of water system, pumping station and filter.

N. C., Southern Pines—Town contemplates erecting steel tower for wooden water tank; 60 ft. high; capy. 200,000 gals. W. P. Mudgett.

N. C., Zebulon—$65,000 bonds voted by city for constr. of water works.

N. D., Leeds—Plans completed for city water works. 500,000-gal. tank (steel) built on 100-ft. steel tower, constr. of 100,000-gal. reinf. conc. reservoir and settling basin, brk. pump house, 100-gal. per min. pump with engine and 21 blks. of 6-in. mains with 14 fire hydrants. Est. cost, $34,173.50.

O., Bryan—Wauseon voted $70,000 bonds to build reservoir and make other impvts. to town's water works system.

O., Jewett—Town voted on water works bond issue; 8 votes lacking to provide two-thirds' majority. Village Council will authorize another election in near future.

O., Springfield—City Mgr. has recommended that City Commision build 2,300 ft. 42-in. c. i. or steel conduit to increase water supply. About $38,000.

O., Wauseon—$70,000 bonds voted at special elec. to build reservoir and make other impvts. in town's water works system.

Ore., Yamhill—$40,000 bonds sold by city; funds to be used for constr. of water works system. Work involves 7½ miles water mains.

Pa., Shenandoah—City having plans prepared by Gannett, Seelye and Fleming, Engrs., 204 Locust street, Harrisburg, for improving water works system to include pumping station, pumps, motors, etc. D. T. Glover, City Engr.

S. C., Andrews—City contemplates calling election to vote on $75,000 bonds for laying water mains in principal streets, boring deep wells, installing well pumps and bldg. pumping station. Tomlinson Engrg. Co., Loan & Exch. Bank Bldg., Columbia, Engrs.

S. C., Lake City—City voted bonds to install water and sewer systems. $150,000 to $200,000.

S. D., Sioux Falls—Resolution passed to construct water mains on 10th from Covell avenue to Western avenue. Geo. W. Burnside, Mayor; Walter Leyse, City Aud.

S. D., Sioux Falls—Special election to be held to authorize bond issue of $200,000 for installing plant for removal of iron from city water; and also extending water mains

to various sections of city.

Tenn., Ripley—City voted $150,000 bonds to construct water and sewer systems, and electric light plants.

Tex., Burkburnett—City issued $150,000 water works and sewer bonds.

Tex., Houston—$250,000 bonds voted for water extensions. A. E. Amerman, Mayor.

Tex., Thurber—Texas Pacific Coal & Oil Co. will organize a million dollar water company. Contemplate bldg. reservoirs at Thurber, Caddo Field and one other location.

Va., Altavista—City will lay 6- and 8-in. water mains to replace present mains. Est. Cost, $5,000.

Wis., Durand—Druar & Smith, 513 Globe Bldg., St. Paul, making plans for sewerage system and water extensions. Ready for bids in July. C. P. Layne, City Clk. $15,000.

Wis., Eau Claire—City considering water works impvts. A. R. Garnock, Consulting Engr.; L. P. Wolff, 1000 Guardian Life Bldg., St. Paul, Minn. New well centrifugal pump, water wheel and generator at pumping station and conc. flume. $100,000.

Wis., Oshkosh—Resolution passed to construct water mains for fire protection and public use. K. R. Rhiley, Chmn. of Bd. of Trustees; G. M. Robinson, Clk.

Wyo., Pine Bluff—$40,000 bonds voted to extend water mains and sewers and also to enlarge light plant.

BRIDGES AND BUILDINGS

Cal., Escondido—Petitions being circulated for erection of two brdgs. across San Luis Rey river; one at Warner dam site, and the other at Rincon Indian Reservation.

Cal., Fresno—Surveyor Jenson preparing plans for new Cerini brdg. over Murphy slough, for the Herndon brdg. and new bulkhead 2 mi. west of Lanare.

Cal., Petaluma—Sonoma County Bd. of Supvrs. have agreed to build two new concrete bridges; one over creek at Kellogs and the other over Sausal crk. Plans adopted for the work.

Cal., Yuba—Supvrs. Sutter Co., have been requested to construct bridge across Sutter by-pass. Est. cost bet. $60,000 and $70,000.

Fla., Pensacola—Escambia Co. Commrs. have authority of legislature to issue $160,000 warrants to constr. 4 conc. brdgs., which will connect with Santa Rosa Co. at Bayous Texar, Marquis, Ferry Pass and Pine Barren crk.

Ga., Griffin—Spalding County Commrs., Griffin and Fayette Co. Commrs., Fayetteville, Ga., will construct steel bridge at People's Crossing, Flint river betwe. Brooks and Vaughn. I. M. Goodman, Supt. Rds., Fayetteville.

Ga., Thomaston—Upson County Commissioners have decided to construct bridge across Flint river.

Ida., Caldwell—Constr. of two Snake river bridges to connect Owyhee and Canyon counties will begin as soon as preliminary steps can be taken. Total cost of both structures, $120,000.

Ida., Twin Falls—Co. Commrs. considering plans for erection of long suspension brdg. across Snake river canyon at Shoshone Falls. Est. cost, $300,000. Plans prepared by R. M. Murray, Billings, Mont. Plans provide for brdg. 1,160 ft. in length betw. the towers at either end; would span the canyon from rimrock to rimrock at height nearly 600 ft. above the river.

Ill. Springfield—Survey completed for Glasser bridge to be built over Sugar creek in Ball Twp. on road bet. New City and Chatham; brdg. to be constructed of rein. conc.; 60-ft. span and 16-ft. driveway.

Ill., Springfield—Ball Twp. will spend $15,000 to eliminate wooden brdgs. from highways; 2 old wooden covered brdgs. are to be replaced by conc. brdgs. this summer.

Ill., Urbana—Rd. and Bridge Comm., Champaign County Bd. of Supvrs., have decided to grant petition of Rantoul Twp. residents for new brdg. 3 mi. east of Rantoul betw. sections 5 and 6. Brdg. will be 50-ft. span, steel superstruc. and rein. conc. flooring. Est. cost abt. $3,500.

Ill., Wilmington—Concrete arch bridge will be constructed here soon.

Ia., Indianola—Board of Supvrs., Warren Co., soon to ask bids for bldg. 120-ft. high steel truss bridge, 16 ft. wide, conc. floor and abutms., 2 20-ft. approach spans on steel tubes. Abt. $12,500. R. E. Boyle Co., Engr.

Ia., Mount Ayr—It is planned to expend abt. $35,000 for a number of bridges and culverts in Ringgold Co.

Ia., Wapello—Plans being prepared by Vail Thompson for rein. concrete bridge, 100-ft span. F. G. Wright, Co. Aud., Louisa county.

Kans., Ottawa—Four county bridges being contemplated for present year in Co. Commrs.' budget. M. E. Alderman, Co. Engr., is at work on plans, some of which are completed; included is a 20- ft. span conc. structure known as the Min Wright bridge to go across branch of Eight Mile crk., near Centropolis; another for which plans are drawn is called Charles Rapp brdg. and will be over small branch N. W. of Lane; 16-ft. span, concrete. Plans now being made for 23-ft. span, conc., to cross Middle crk. near Princeton.

La., Mermenton—Acadia Parish Police Jury, Crowley, La., and Jefferson Davis Parish Police Jury, Jennings, will construct conc. or iron bridge across Mermenton river to connect two parishes. $30,000.

Md. St. George Island—State Rds. Comn., 601 Garrett Bldg., Baltimore, will construct bridge to connect St. George Island, St. Marys county, with mainland.

Mass., Holyoke—City contemplates bldg. conc. culvert in Elmwood Park. Abt. $15,000. T. J. McCarty, City Engr.

Mass., Holyoke—Boston & Maine R. R., No. Shore Sta., Boston, plans to construct 15,000 ft. steel and conc. brdg. over Conn. river from here to Willimansett, to replace present structure. A. A. Corthell, Boston, Chf. Engr.

Minn., Anoka—Plans prepared by L. P. Wolff, 920 Guardian Life Bldg., St. Paul, for memorial bridge over Rum river at Main street.

Minn., Barnesville—Clay County Commrs. have voted to construct steel and conc. bridge across South Buffalo river on Moorhead-Barnesville State Rd.

Minn., Biwabik—Plans being prepared by Town. Engr. Dorway, for concrete bridge over Embarrass river on Vermillion road, 30 ft. long and 20 ft. wide.

Minn., Minneapolis—Member of Hennepin Co. Bd. have voted to constr. Lyndale avenue bridge. Cedar avenue bridge will also be repaired. Est. cost of two projects, $750,000. Included in petition to repair Cedar avenue brdg. is constr. of rd. 10 mi., directly So. from end of brdg. to Nichols, then 4 mi. east to Farmington.

Minn., Red Lake Falls—Indian Department will appropriate $3,000 to construct bridge across outlet of Red Lake river.

Mo., Poplar Bluff—Butler Co. Commrs., Poplar Bluff and Stoddard Co. Commrs., Bloomfield, Mo., contemplate constr. of bridge across St. Francis river.

Neb., Hastings—Bd. of Supvrs. has ordered constr. of 9 new conc. brdgs. in county; 4 will be located in Roseland Twp.; 2 in Ayr; 2 in Silver Lake, and 1 in Cottonwood.

N. C., Fayetteville—$10,000 bonds will be issued by city for constr. of conc bridges. Jno. Underwood, Mayor.

N. D., Valley City—Petition for bridge in Marsh Twp., Barnes county, approved by Twp. Bd.

O., Georgetown—Plans being prepared for bridges and culverts on West Union road, Clark Twp., Brown county. Est. cost, $54,000.

Ore., Astoria—Port of Astoria is to cooperate in constr. of new brdg. across Young's Bay. Plans now being prepared by State Engr., for steel structure and lift draw. Plan is to provide room in center of bridge for belt line railroad, with driveways on either side, including foot path.

Ore., Oregon City—State Hwy. Comn., Salem, contemplates bldg. 385-ft. bridge over Willamette river, struct. steel encased in concrete, 5 per cent. grade. Abt. $268,000. C. B. McCullough, Capitol Bldg., Salem, State Brdg. Engr.

Pa., Harrisburg—Public Service Comn. has approved plans for hill to hill bridge to connect North and South Bethlehem.

C. S., Columbia—Plans being drawn at offices State Hwy. Comn., for 4,000-ft. bridge to be built bet. Port Royal Island and St. Helena Island, near Beaufort. Bridge will be one mile long and will be constructed of conc.; $160,000 available for construction of bridge.

Va., Goodes Ferry—Steel bridge planned over Roanoke river. J. E. Boyd, South Hill.

Wis., Cumberland—Plans prep. by Wis. Hwy. Comn., for McLellan Bridge, Barron Co., town of Sumner; 60x16-ft. plt. girder, conc. abutms. Ed. Gleason, Co. Commr.

Wis., Ellsworth—$5,200 bonds voted for bridge construction.

Wis., Lancaster—Granty county, town of Lancaster. Plans prepared by Wis. Hwy. Comn., for Adams Bridge, 50x16 ft. plt. girder span, conc. abutms. Henry Mink, Co. Commr.

Wis., Manitowoc — Manitowoc county plans to build 174-ft. steel bridge at 14th street, 30-ft. wide, with earth approaches and conc. abutments. Abt. $35,000. Wk. involves 800-cu. yds. rein. conc. and 2,00 cu. yds. concrete. F. L. Alter, City Hall, Engr.; also a steel or rein. conc. bridge over 21st street, 750 ft. long, 36 ft. wide, involving 1,000 cu. yds. rein. conc. and 1,500 to 2,000 cu. yds conc., etc. Abt. $50,000.

Wis., New Richmond—City considering bldg. bridge over Willow river—approx. 110 ft. J. E. Hughes, City Clk.

Wis., Onalaska—Plans drawn for Wells bridge in town. Private plans. Wis. Hwy. Comn. Jno. Hintgen, Comr., La Crosse, Wis. Est. cost, $8,600.

Wis., Phillips—Plans being prepared for rein. conc. bridge in Price Co.

Wis., Portage—If efforts of citizens of Prairie du Sac and West Point are successful, a bridge 1,474 ft. long will be constructed across the Wisconsin river betw. the towns. Est cost, $144,000. Structure will be of steel with 18-ft. roadway carried on rein. conc. piers, including movable span which will fulfill the requirements of the War Dept.

Wis. Rhinelander—County Board has passed favorable action on three brdgs., in accord. with petitions submitted to Bd. by Town Bds., Bine Lake, Woodboro and Cassian. Woodboro asks for bridge over Rice crk., where Woodboro and Heafford Jct. rd. crosses creek. Est. cost, $1,600. Pine Lake petition calls for brdg. at Swails on Rhinelander and Gagen rd. Est. cost, $1,400. Cassian asks for bridge over Horsehead crk. $600.

Wis., Sparta—Monroe co., town of Greenfield. Plans prep. by Wis. Hwy. Comn. for McMullen brdg., 10x24 ft. rein. conc. brdg., conc. abutms.

Wis., Washburn—County Bd., Bayfield county, has voted to erect steel bridge over Sioux river. 300 ft. long and 50 ft. wide. Neis M. Oscar, County Aud.

Wisconsin—La Cross county, Holland, will build Gaader brdg.; 38x18 ft., I-beam span, conc. abutments. Bert A. Jolivett, Co. Aud.; Shawane Co., Angelica, will construct Zernicke brdg., 20x24 ft. rein. conc. span, conc. abutms.; Bonion brdg. 14x20 ft. rein. conc. span, conc. abutms., Osieasenak brdg., 10x20 ft. rein. conc. span, conc. abutms. and Hanstad brdg., 14x20 ft. rein. conc. span, conc. abutms, town of Morris, Town line brdg., 10x16 ft. rein. conc. span, conc. abutms. Otto A. Wiegand, Co. Aud.; Sheboygan Co., Herman, will build Reinking brdg., 12x12 ft., rein. conc. span, conc. abutms. Fred Kneeverrs, Co. Aud.

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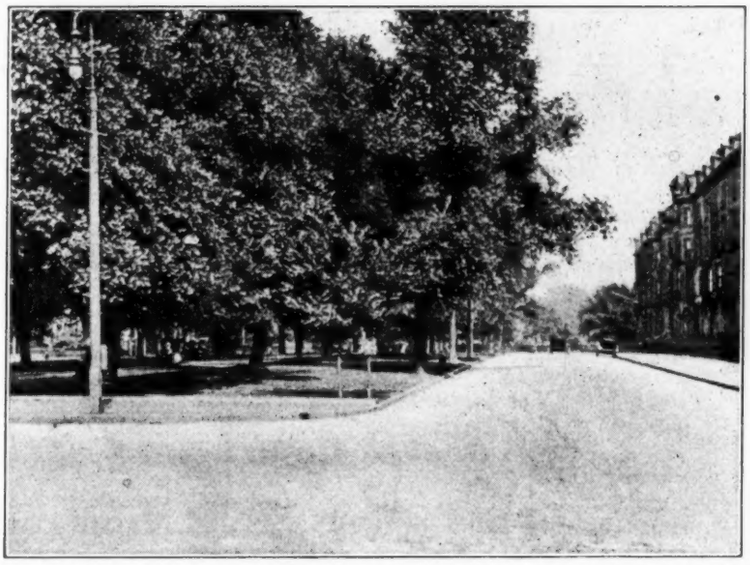

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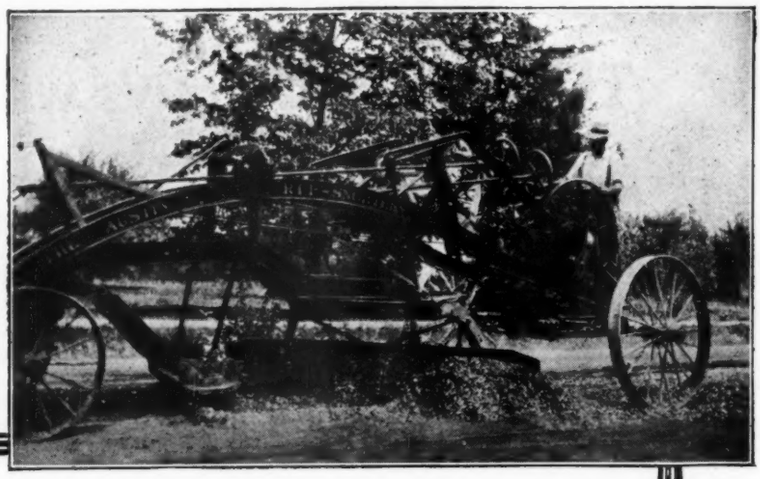

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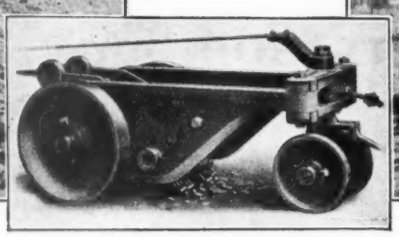
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